MAY, 1955

RUBBER WORLD

NOW IN ITS 66th YEAR

A BILL BROTHERS PUBLICATION

"FREE, COMPETITIVE SYNTHETIC RUBBER INDUSTRY" IS ACHIEVED

see page 226

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News about

B. F. Goodrich Chemical *raw materials*

HYCAR 1312

practical polymer, proved plasticizer

Check these three proved uses:

Hycar 1312 . . . a *liquid* nitrile polymer . . . mixes and compounds readily without the need for costly equipment . . . cures to medium or hard state using regular compounding ingredients . . . has excellent resistance to oil, grease, solvents.

Hycar 1312 . . . a nitrile rubber plasticizer . . . non-migrating, non-extractable...non-volatile...contributes to better flow, extrusion, and calendering of nitrile rubber stocks . . . produces roll building compounds with excellent tack and knitting characteristics.

Relatively small amounts of Hycar 1312 in the recipe will sharply reduce the viscosity of uncured compounds . . . an effect useful in producing nitrile sponge and friction compounds.

Hycar 1312 . . . a polymeric-type plasticizer for vinyl plastisol compounding . . . produces excellent, dimensionally stable pressure-blown sponge at expansion temperatures of 300-305° F. without surface cracking . . . produces finished products of excellent physical characteristics.

Hycar 1312 and its many unique advantages are completely described in a new bulletin just released. Please write Dept. CL-5, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

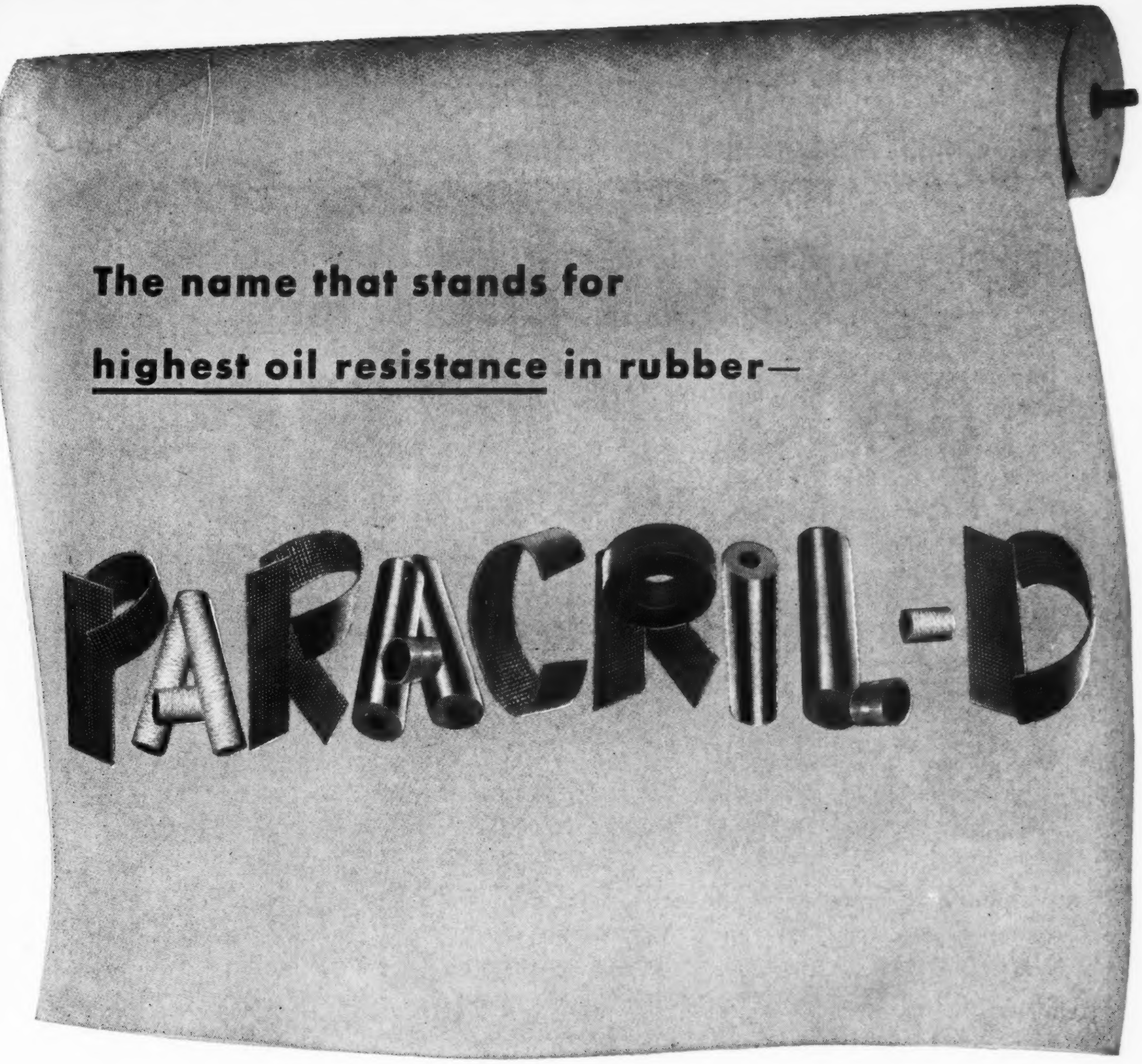
B. F. Goodrich Chemical Company

A Division of The B. F. Goodrich Company

Hycar Reg. U.S. Pat. Off.

American Rubber

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors



Today's industry uses many products made of rubber. It also uses lots of oils, solvents, and other chemicals that cause ordinary rubbers to soften, swell, and become useless... *but not* PARACRIL® D.

PARACRIL D is the latest and most oil-resistant of the entire PARACRIL family, butadiene acrylonitrile synthetic rubbers produced by Naugatuck. This is the rubber of very high nitrile content which retains good flexibility and excellent processing properties. It also provides good tensile properties and excellent abrasion resistance, as well as unequalled resistance to petroleum and animal oils, esters, aromatic hydrocarbons, and chlorinated organic liquids. All the PARACRILS are *non-discoloring* and *non-staining*.

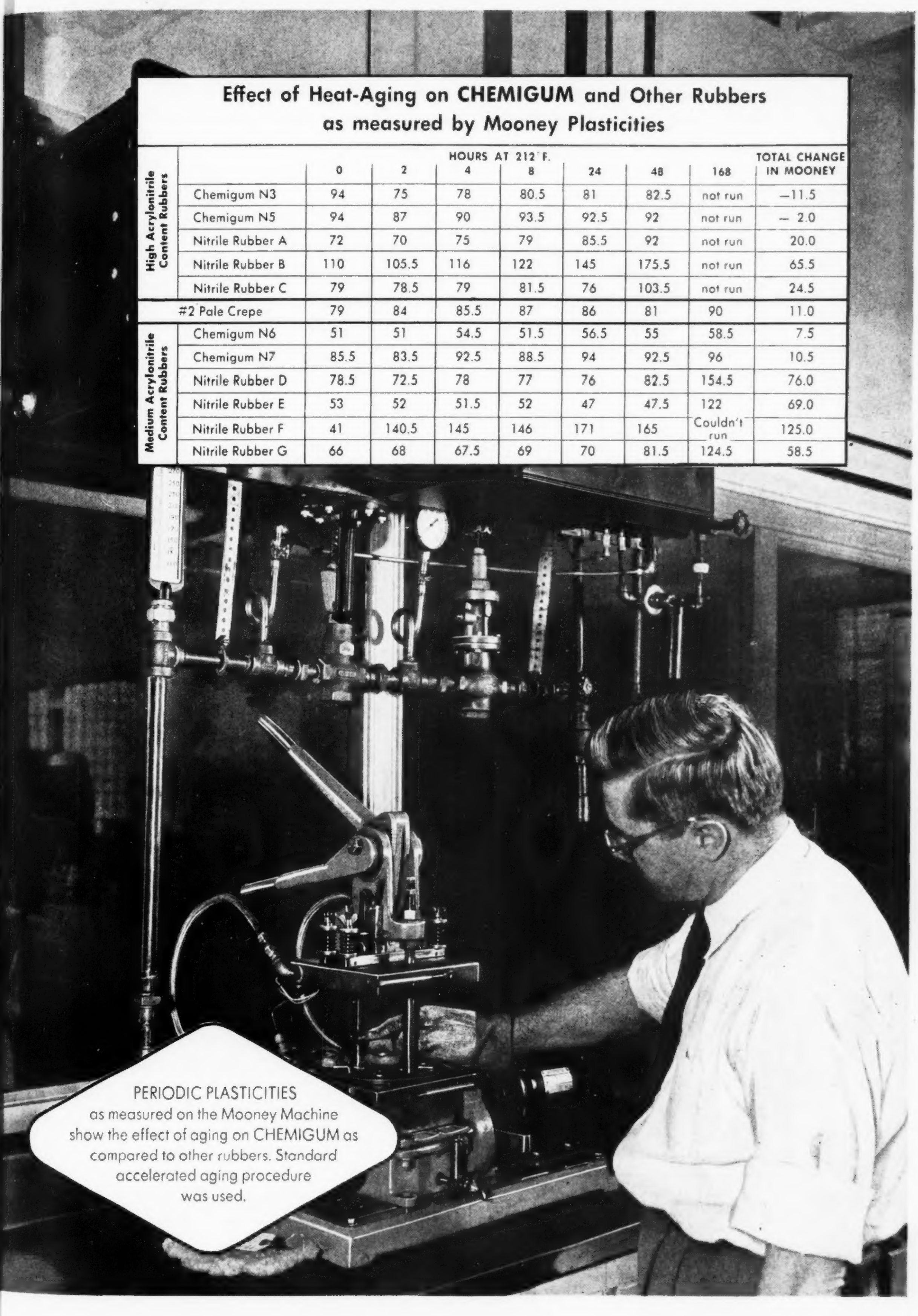
If *you* manufacture or use oil-resistant rubber parts or products, for any purpose, write for the latest data on PARACRIL D today.

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • IN CANADA: Naugatuck Chemicals, Elmira, Ontario
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.

CHEMIGUM . . . another quality product of Goodyear Chemical Division



Effect of Heat-Aging on CHEMIGUM and Other Rubbers as measured by Mooney Plasticities

		HOURS AT 212° F. 0	2	4	8	24	48	168	TOTAL CHANGE IN MOONEY
High Acrylonitrile Content Rubbers	Chemigum N3	94	75	78	80.5	81	82.5	not run	−11.5
	Chemigum N5	94	87	90	93.5	92.5	92	not run	− 2.0
	Nitrile Rubber A	72	70	75	79	85.5	92	not run	20.0
	Nitrile Rubber B	110	105.5	116	122	145	175.5	not run	65.5
	Nitrile Rubber C	79	78.5	79	81.5	76	103.5	not run	24.5
	#2 Pale Crepe	79	84	85.5	87	86	81	90	11.0
Medium Acrylonitrile Content Rubbers	Chemigum N6	51	51	54.5	51.5	56.5	55	58.5	7.5
	Chemigum N7	85.5	83.5	92.5	88.5	94	92.5	96	10.5
	Nitrile Rubber D	78.5	72.5	78	77	76	82.5	154.5	76.0
	Nitrile Rubber E	53	52	51.5	52	47	47.5	122	69.0
	Nitrile Rubber F	41	140.5	145	146	171	165	Couldn't run	125.0
	Nitrile Rubber G	66	68	67.5	69	70	81.5	124.5	58.5

PERIODIC PLASTICITIES
as measured on the Mooney Machine
show the effect of aging on CHEMIGUM as
compared to other rubbers. Standard
accelerated aging procedure
was used.

We make our own fine alloy steel—and make it nickel-rich—to make TIMKEN® bearings tougher

NICKEL makes steel tougher. So, our steel-making specialists don't skimp on nickel in the fine alloy steel we make for Timken® tapered roller bearings. They use exactly the right amount of nickel to give these bearings the toughness they need to withstand shock and last longer. Exacting quantities of chromium or molybdenum or both guarantee uniform hardness. By using the steel industry's first direct-reading spectrometer, we exercise hairline control of each element at the precise instant of tapping the furnace.

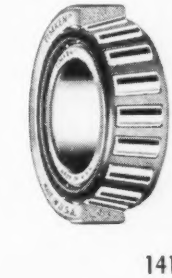
Rolling, annealing, and cooling are done with the same meticulous care. And every race and roller that goes into a Timken bearing is precision case-carburized to give it a hard, wear-resistant surface over a tough, shock-resistant core.

We've been specializing in the production of fine alloy steel for almost forty years. We're the only bearing manufacturer in the country that makes its own steel, because it's the only way we can make sure the quality of our bearing steel is just the way we want it. Steel is the heart of the bearing. That's why we insist on controlling bearing quality *every* step of the way—from melt shop to final bearing inspection. And that's why we don't skimp on the use of nickel.

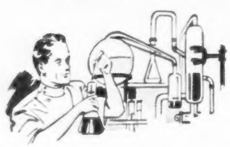
To be absolutely sure of the highest performance standards in the equipment you build or buy, always specify Timken tapered roller bearings. They are made from seamless tubing or forgings by the most modern processes, under strict control. Only Timken bearings roll so true, have such quality thru-and-thru. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

Only **TIMKEN®** bearings roll so true, have such quality thru-and-thru

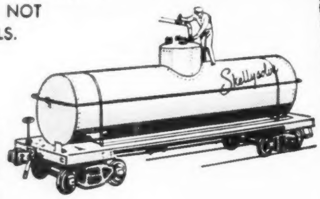


HERE'S HOW SKELLYSOLVE CAN HELP SOLVE YOUR SOLVENT PROBLEMS:



1) SKELLYSOLVE IS CONTINUALLY TESTED FOR QUALITY AND SHIPPED IN SPECIAL TANKCARS NOT USED FOR HEAVY FUELS.

3) CAR NUMBER AND SHIPPING INFORMATION ARE SENT TO YOU PROMPTLY.

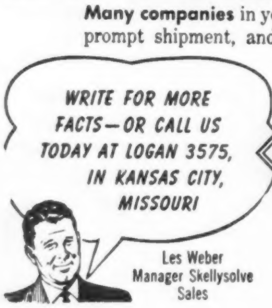


2) SKELLYSURE DELIVERY IS FAST. YOUR ORDER IS PHONED DIRECT TO THE PLANT...9 TIMES OUT OF 10 YOUR CAR IS SHIPPED THE NEXT DAY.

4) SKELLY'S STORAGE AND TRANSPORTATION FACILITIES HELP ASSURE DEPENDABLE SERVICE. EVEN THE NATION'S WORST FLOODS HAVE NEVER STOPPED SKELLYSOLVE!

5)...AND BACK OF EVERY DROP OF SKELLYSOLVE IS THE SKELLY RECORD OF 25 YEARS OF PIONEERING LEADERSHIP IN THE INDUSTRY!

Many companies in your industry depend on Skellysolve for exacting quality, prompt shipment, and technical service. Get more complete facts today.



Les Weber
Manager Skellysolve
Sales

SKELLY **Skellysolve**

SKELLY OIL COMPANY
Industrial Division
605 West 47th Street, Kansas City 41, Mo.

Skellysolve for Rubber and Related Industries

Applications

SKELLYSOLVE-B. For making quick-setting cements for the shoe, tape, container, tire and other industries. Quick-drying, with no foreign taste or odor in dried compound.

SKELLYSOLVE-C. For making quick-setting cements with a somewhat slower drying rate than those compounded with Skellysolve-B.

SKELLYSOLVE-D. For cements and variety of manufacturing operations. Good odor. Quick drying. Minimum of heavy, greasy compounds.

SKELLYSOLVE-H. For general use in manufacturing operations and cements, where faster evaporation rate than that of Skellysolve-D is desired.

SKELLYSOLVE-E. For use wherever a relatively slow drying solvent is desired.

SKELLYSOLVE-R. For general use in tire building and a variety of other manufacturing operations and cements. Reduces evaporation losses. Medium quick final dry. Lessens bloating and skinning tendency.


ANOTHER QUALITY CHEMICAL BY GENERAL TIRE
KURE-BLEND MT®
. . . a true masterbatch
providing excellent dispersion
Kure-Blend® MT is a latex-compounded masterbatch containing 50% Tetramethyl Thiuram Disulfide and 50% GR-S Type Rubber. If you want the ultimate in fast easy mixing and excellent dispersion, use Kure-Blend.
For sample and reference data on Kure-Blend MT write to The General Tire & Rubber Company, Chemical Division, Akron, Ohio, or our
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General Tire also produces . . .
Vygen* (Polyvinyl Chloride) • Gen-Flo* (Paint Latex)
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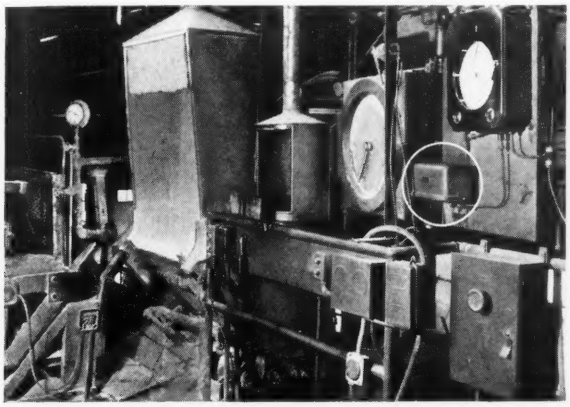
*T. M. G. T. & R. Co.
Chemical Division
GENERAL
THE GENERAL TIRE & RUBBER CO.
KURE-BLEND MT

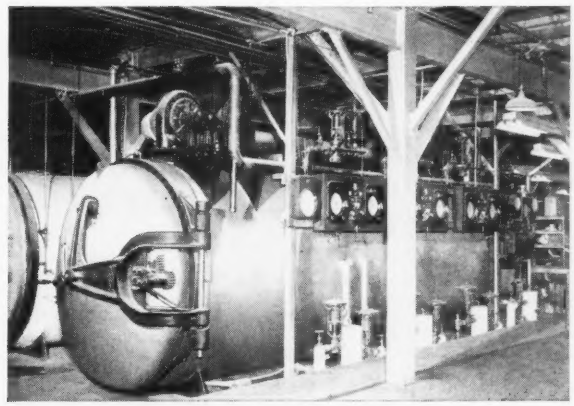
Who controls the RUBBER INDUSTRY?

WHEN it comes to control of the various processes involved in the production of the finished article, Taylor instruments play an important role. From the accurate measurement and control of the mix in a Banbury, to the fully automatic control of modern tire presses, there are Taylor systems designed to save you money; help maintain product quality. Call your Taylor Field Engineer. Or write Taylor Instrument Companies, Rochester, N. Y.; Toronto, Canada.

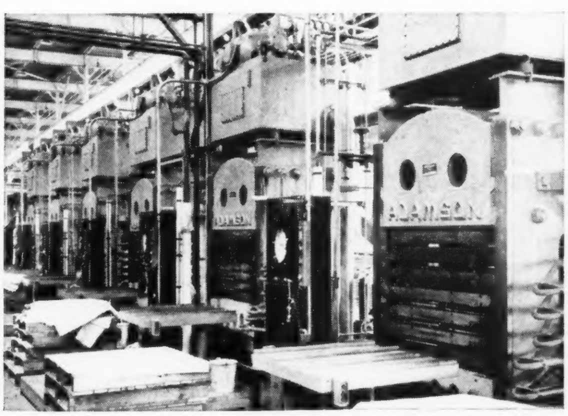


On this Banbury mixer the rugged yet highly responsive measuring system of the TRANSAIRE* Temperature Transmitter (circled) compensates for the poor heat transfer of the mix. The FULSCOPE* Controller accurately records and controls the time and temperature of each batch. Cuts out heat deterioration worries—and risk of fire.

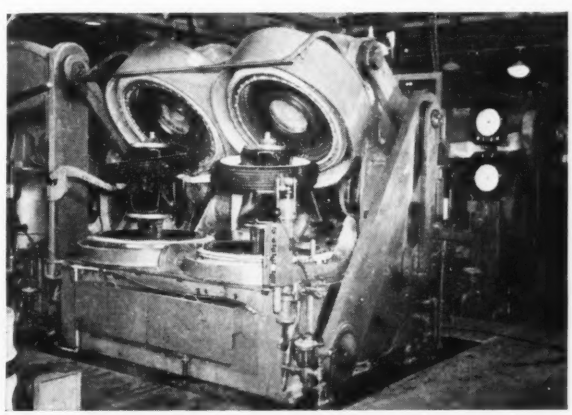
*Reg. U.S. Pat. Off.



A Taylor control system masterminds the operation of these boot and shoe vulcanizers. Steam temperature to the heating coils and air pressure inside the vulcanizers are both controlled, while the system automatically times the cycle, shuts off the air and vents the vulcanizer.



Taylor controls the entire operation of these multi-platen presses, from closing to opening. In addition, steam pressures are automatically regulated and recorded, condensate temperature is recorded—and condensate is disposed of at adjustable repeating intervals.



The sequence and duration of all the functions of this Bag-O-Matic Press are automatically controlled by Taylor instrumentation, from closing to opening of the press. This includes control of press temperature and condensate removal in each cavity, and the recording of bag pressure to each press.

Taylor Instruments **MEAN ACCURACY FIRST**

How to reduce your mixing cycle without sacrificing dispersion or physicals

High-pressure mixing is an improvement of standard mixing procedures used since the introduction of the Banbury® mixer to the rubber industry. Pressures on the material in the mixing chamber are two to three times as high as those normally considered standard.

When mixing master batches, all of the rubber and fillers are fed into the machine at the same time. With high pressure on the floating weight, mixing cycles have been cut—as much as 40%. The resulting short cycle reduces the heat history of the compound. Thus, processing problems caused by polymer gel, cross linkage or heat degradation are avoided.

Dispersion and physicals are equal to, or better than, those obtained with standard procedures. Best results have been on the stiffer compounds, like tire tread, soling and matting, which offer considerable resistance to mixing.

Increased pressures mean high but short horsepower load conditions. Uni-drives are generally necessary, and the Banbury itself has been redesigned to provide a more rugged machine for this severe service.

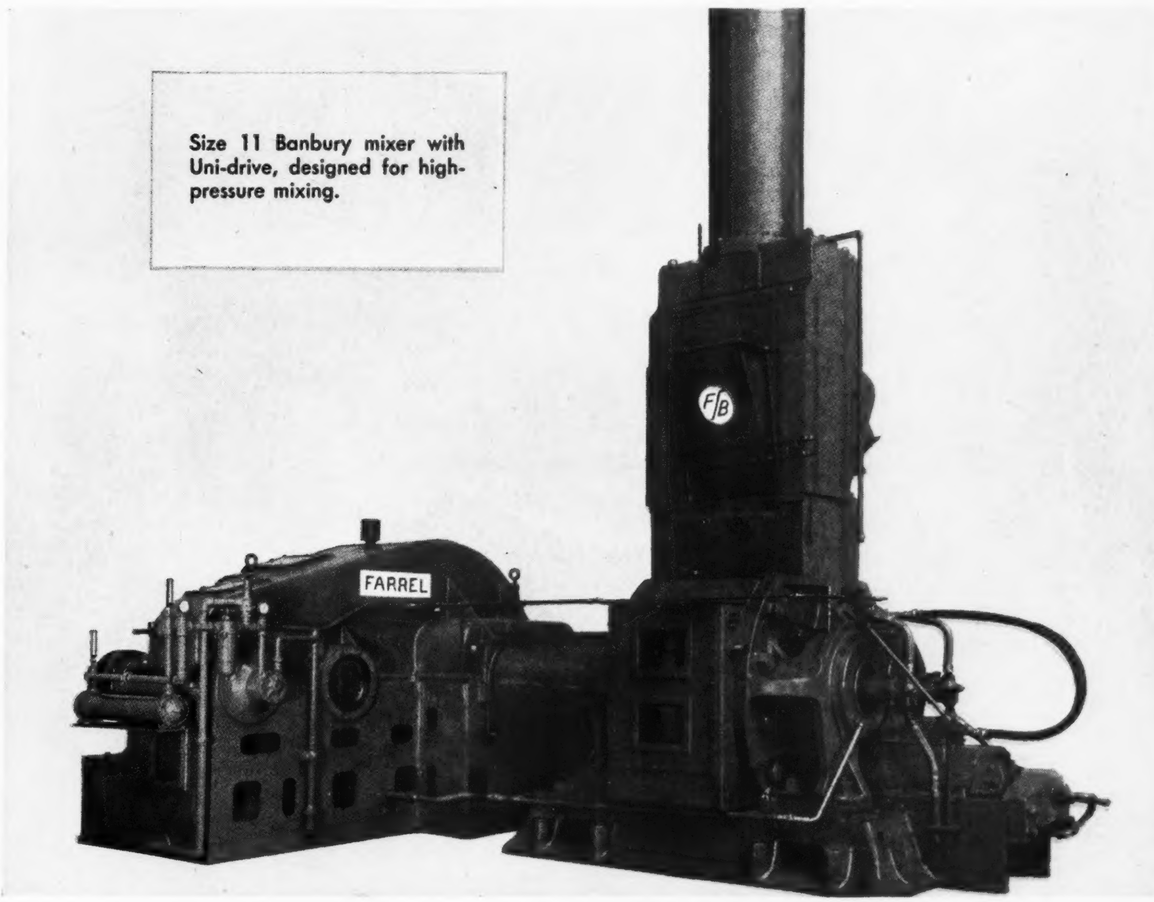
This and other applications of the Banbury mixer are detailed in Bulletin No. 198. You may have a copy, without obligation.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Fayetteville (N. C.), Los Angeles, Houston

FB-1004

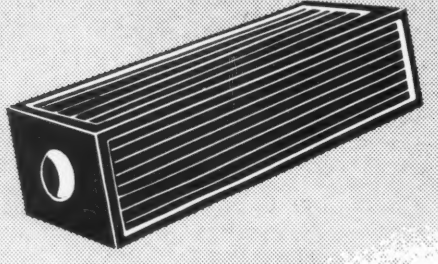


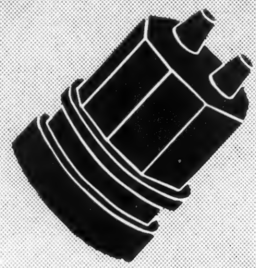
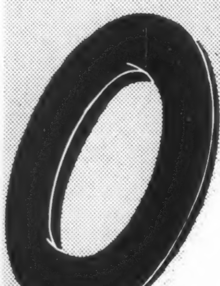
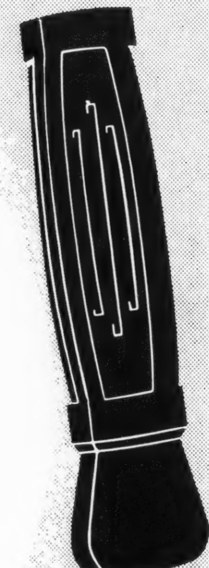
Size 11 Banbury mixer with Uni-drive, designed for high-pressure mixing.

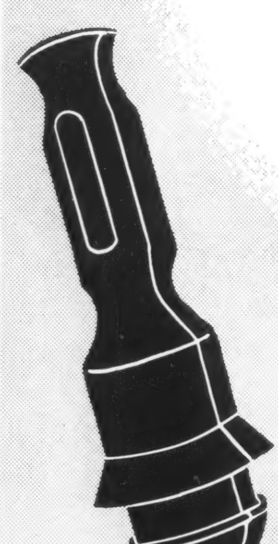
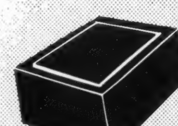
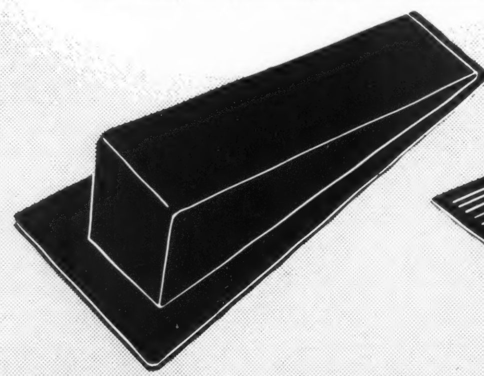
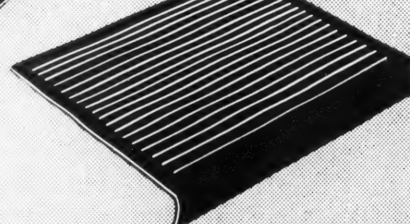
Farrel-Birmingham®

F-B® PRODUCTION UNITS

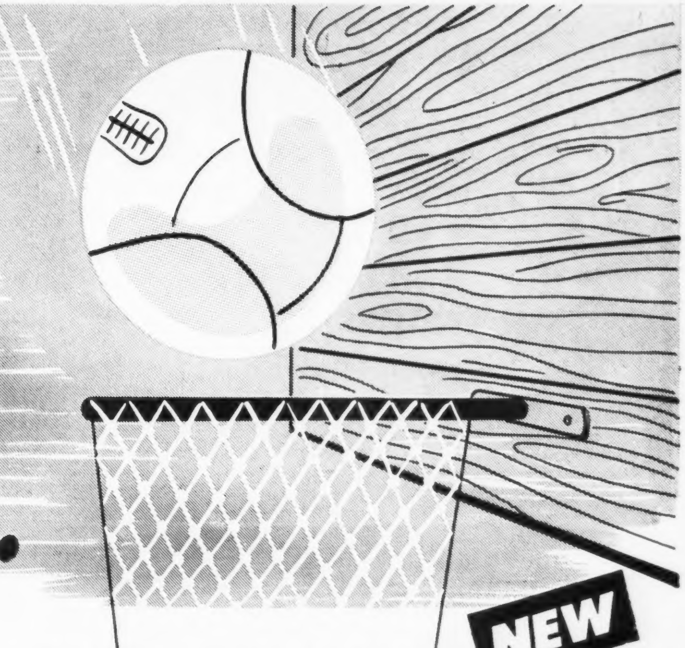
Banbury Mixers • Plasticators • Pelletizers • Extruders • Calenders • Mixing, Grinding, Warming and Sheeting Mills • Refiners • Crackers • Washers • Hose Machines • Bale Cutters • Hydraulic Presses and Other Equipment for Processing Rubber & Plastic Materials.



Point for Point...



NEW Marbon "8000-A"®

Reinforcing High Styrene Resin

for Reinforcing Inflated Ball-Cover Compounds

Marbon "8000-A" resin fluxes rapidly at lower temperatures (165-175 degrees F.) for improved dispersion, shorter mixing cycles, faster heat-plasticizing action with lowered power demand.

A superior-processing resin with all the reinforcing properties of Marbon 8000. Especially suitable for OPEN MILL mixing under marginal heat conditions.

- **Greater Uniformity, Lighter, Brighter Colors**
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- **Allows Cooler Mixing for Better Pigment Dispersion**
- **Adds Excellent Abrasion and Tear-Resistance, High Modulus and Longer Flex-Life.**

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MARBON CHEMICAL

Division of BORG-WARNER

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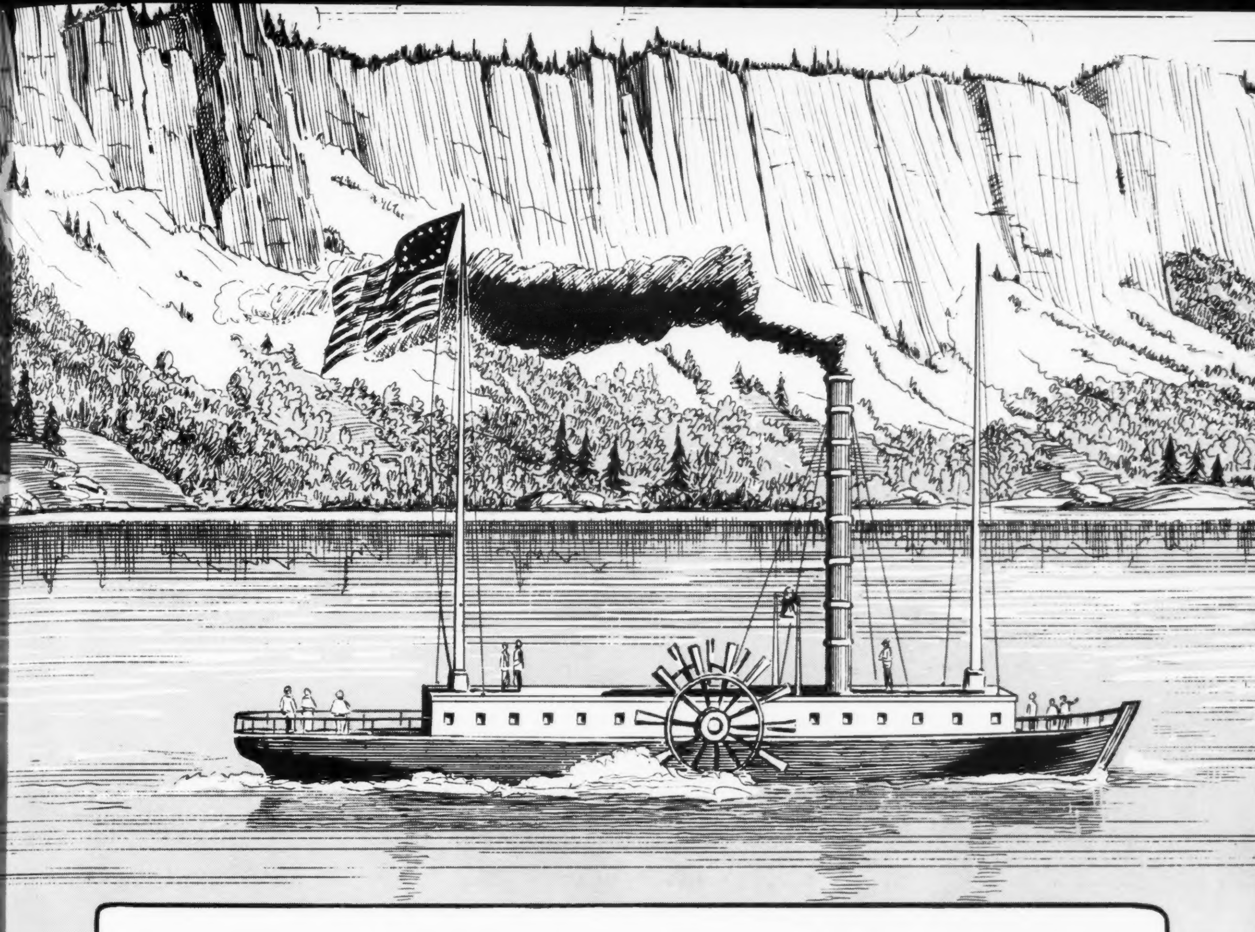
It BLENDS as it STRENGTHENS as it IMPROVES



Sawmill on the Way to Albany

One of a series on transportation and famous trails.

Early in the spring of 1807 at the shipyard of Charles Brown on East River, and under the direction of Robert Fulton, construction began on the S.S. Clermont. Both then and weeks later when the machinery was being installed, the strange craft was the subject of as much talk and criticism, as though it had been Noah's Ark, an early historian states.

In August the S.S. Clermont was ready for its maiden trip — to Albany. With several distinguished guests aboard, the boat got under way and headed up the Hudson river. Pine was used for fuel, which sent immense columns of showering sparks and black smoke from the tall smokestack. It is said that crews of other vessels along the way were appalled at the sight, especially after dark. As the Clermont passed the Palisades the clanking of its machinery and the noise of its paddle wheels so startled a farmer that he ran home to tell his wife that he had just seen "the devil on his way to Albany in a sawmill."

Fulton reached Albany, having traveled at the rate of 5 miles per hour for the full 150 miles. (The return trip was two hours quicker.) This was the first voyage of any considerable length ever made by a steam vessel.

Quickly in the years that followed the rivers of the United States became great highways for commerce. Up and down the Ohio the steamboats went, on the Mississippi and other inland waterways. A score of years later Indians in the far west heard steamboat whistles far up the wide Missouri. A continent was further opened and a great step forward was taken in the hauling of commerce.

Today man transports himself and his goods wherever he wishes to go. Neither proximity to a river nor to a railroad is any deterrent whatsoever in the swift haulage of the products of farm and factory. The rubber tire carries the greater part of the commerce of the day. Durable, dependable with long life and economy built into it, the rubber tire is equal to today's demands in every way.

It is carbon black which imparts these wearing qualities. UNITED BLACKS helped pave the way through research and engineering, thus contributing to the high standards which the modern tire represents.

UNITED CARBON COMPANY, INC.

C

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THIS SIDE UP · STORE IN A COOL PLACE
HERCULES
DEFOAMER 4
PATENT APPLIED FOR
HERCULES POWDER COMPANY
NET WEIGHT 2½ LBS.
STORE IN A COOL PLACE
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Here's how we help sell over 1

RAYON HI-TEST* T

First ad in a powerful 4-color campaign, appearing in

LIFE
(MAY 30)

SATURDAY EVENING POST
(MAY 28)

COLLIER'S
(MAY 27)

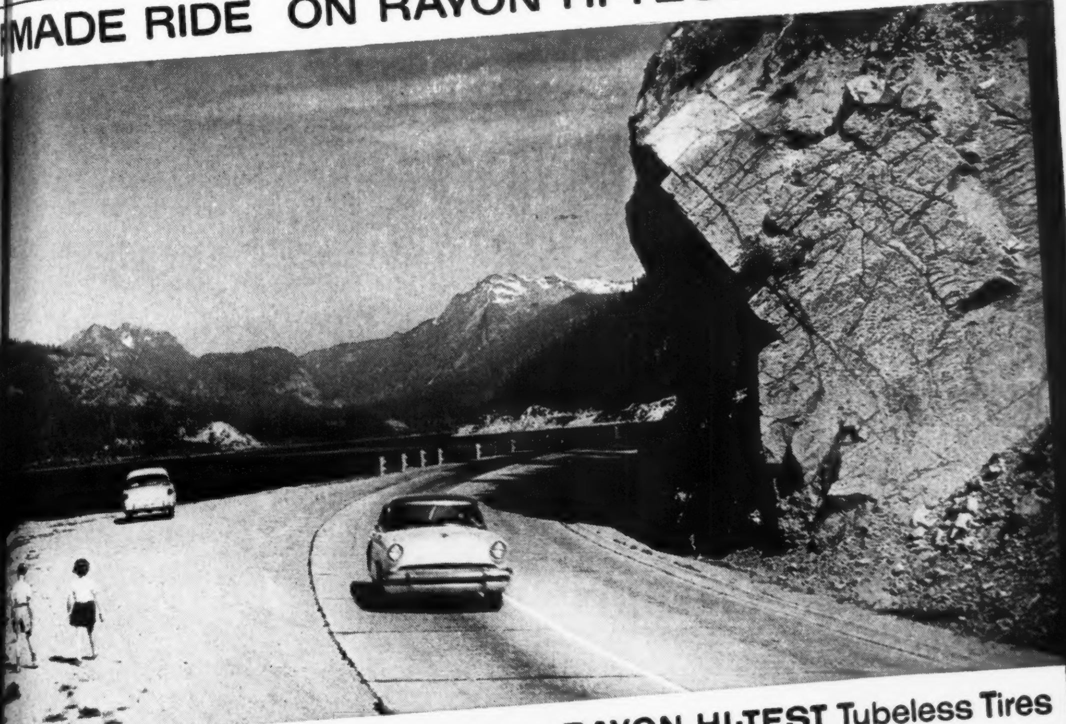
Watch for these ads . . . clip them . . . post them in a prominent place.

* Our word for describing special high tenacity tire rayon to consumers.

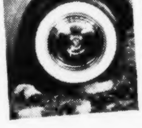
ver 11,000,000 customers on

T* TUBELESS TIRES

EVE MADE RIDE ON RAYON HI-TEST CORD!



are eqpped with stronger, longer-lasting **RAYON HI-TEST** Tubeless Tires



Rayon takes hard knocks. Rough roads, quick stops, sudden starts, swerving ruts and bumps all put severe strain on tire cord. Because its tensile strength is comparable to that of steel, today's improved rayon offers higher resistance to impact, friction and rupture.

The new '55 models are the safest in automobile history. Tubeless tires strengthened with RAYON HI-TEST tire cord are one big reason why! They were *unanimously* chosen by car manufacturers as original equipment. The amazing resistance of these new tubeless tires to blowouts and punctures, their matchless performance and all-round dollar value are made possible by the vastly *increased strength* of RAYON HI-TEST tire cord. Take a tip from the car manufacturers. Even if you don't own one of the new '55's, *you* can enjoy the benefits of RAYON HI-TEST tire cord. When it comes time to replace the tires on your present car, choose RAYON HI-TEST Tubeless Tires. You get *premium safety at no premium in price.*

AMERICAN RAYON INSTITUTE, 350 FIFTH AVE., NEW YORK 1, N. Y.

Be sure you ride on **RAYON–World's Leading Tire Cord**

AMERICAN RAYON INSTITUTE

CHECK THESE SELLING POINTS FEATURED IN EVERY AD!

- Rayon Hi-Test Tubeless Tires original equipment on the '55 cars!
- Rayon cord strength improved 33⅓% . . . fatigue resistance increased 4 to 5 times . . . tire mileage lengthened up to 60%.
- Rayon Hi-Test Tubeless Tires give premium safety at no premium in price!

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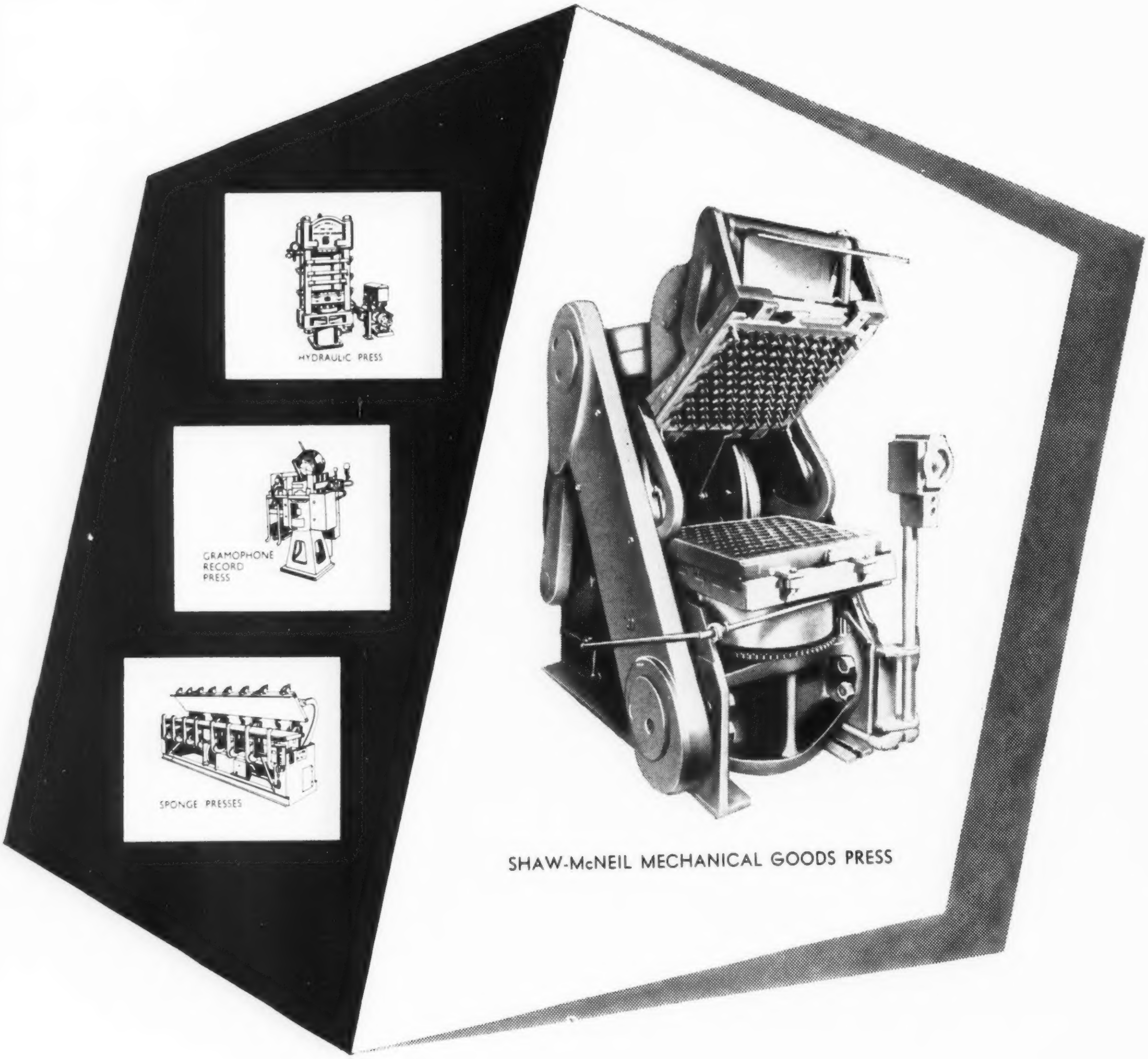
D

High output with uniformity

automatically assured



Uniformity is the key to production. The Shaw range of hydraulic and mechanical presses ensure this uniformity on a multifarious range of products.

The SHAW-McNEIL Mechanical Goods Press featured is only one of an outstanding range of machinery. Motor operated—no hydraulics—it maintains 780 lbs. p.s.i. platen pressure, and allows for simple, quick adjustment of the lower platen adjustments for mould loadings of zero to 400 tons.

SHAW presses for rubber and plastics

FRANCIS SHAW & COMPANY LIMITED, MANCHESTER 11, ENGLAND

London Office: 34 Victoria Street, London, S.W.1.

Enquiries to FRANCIS SHAW (CANADA) LTD., GRAHAM'S LANE, BURLINGTON, ONTARIO, CANADA

P 816


NEVILLE
Oils
"On Top of the Heap"
for reclaiming Rubber
LX-572
LX-777
X-1
You'll find at least one of these oils the answer in your own particular reclaiming operation.
You'll get the advantage of low tailings, smooth processing, and uniformity of product, even with mixed synthetic and natural stock.
Your result—a reclaim having controlled tack and improved tensile.
If you need these important qualities, you should investigate the Neville line of Reclaiming Oils. Write for information and samples.
Chemicals for the Rubber Industry
NEVILLE CHEMICAL CO.
PITTSBURGH 25, PA.
Plants at Neville Island, Pa., and Anaheim, Cal.
R-49


QUICK TRIM FLASHING
for as little as
¼ your present cost!
with Western's
RMH Machine
The machine of 1000 Uses
WESTERN
Dies cut on a replaceable hardened steel plate. Foot control speeds operation. Simple, positive pressure adjustment. Positive safety devices on machine. ½ H.P. motor.
Cuts, punches and trims flashing
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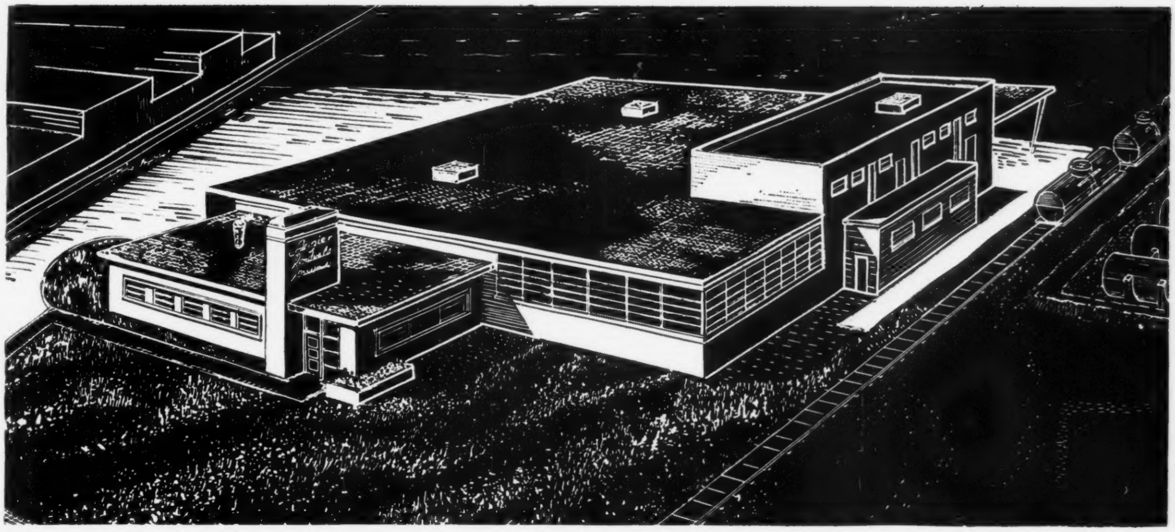

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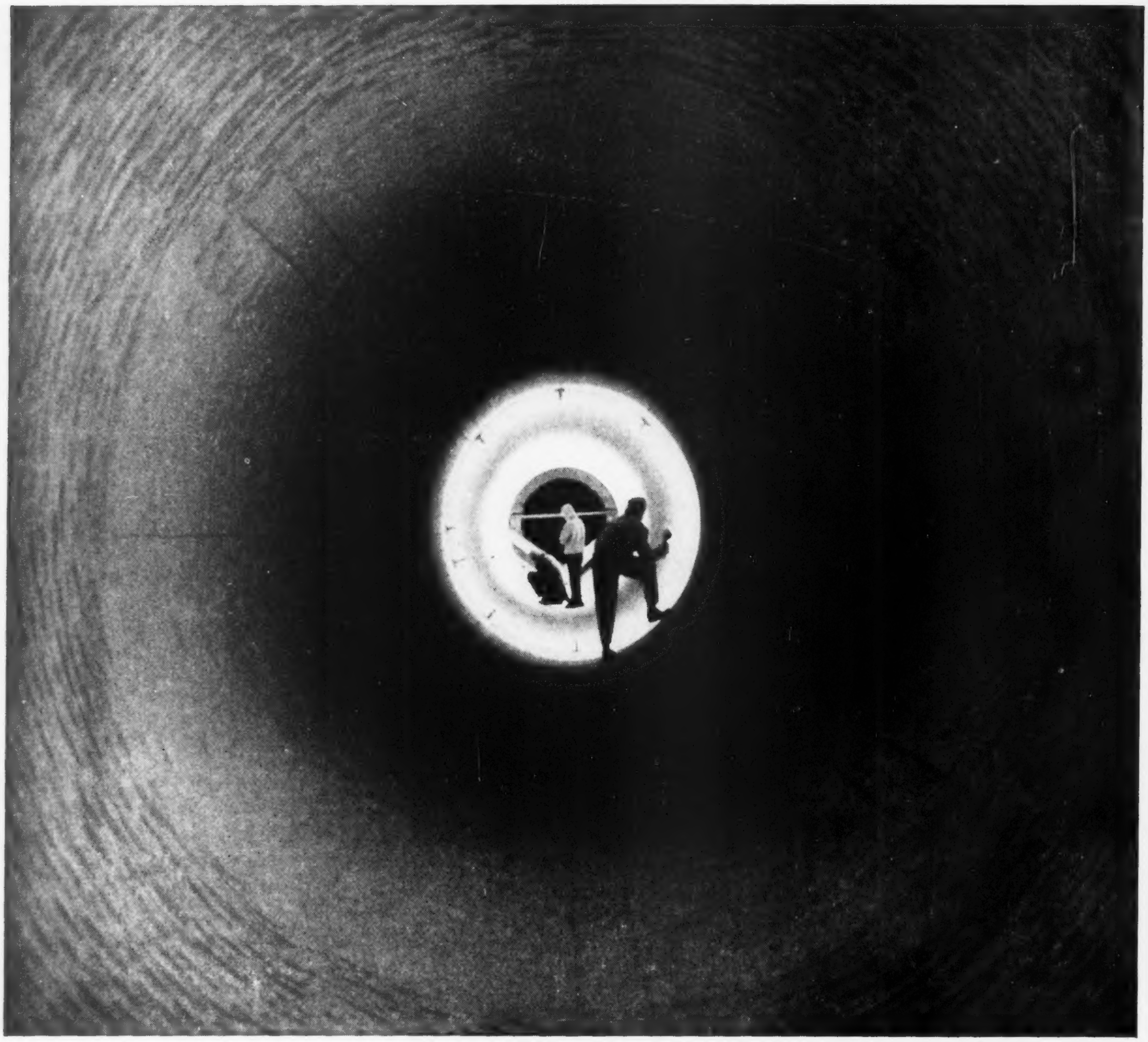

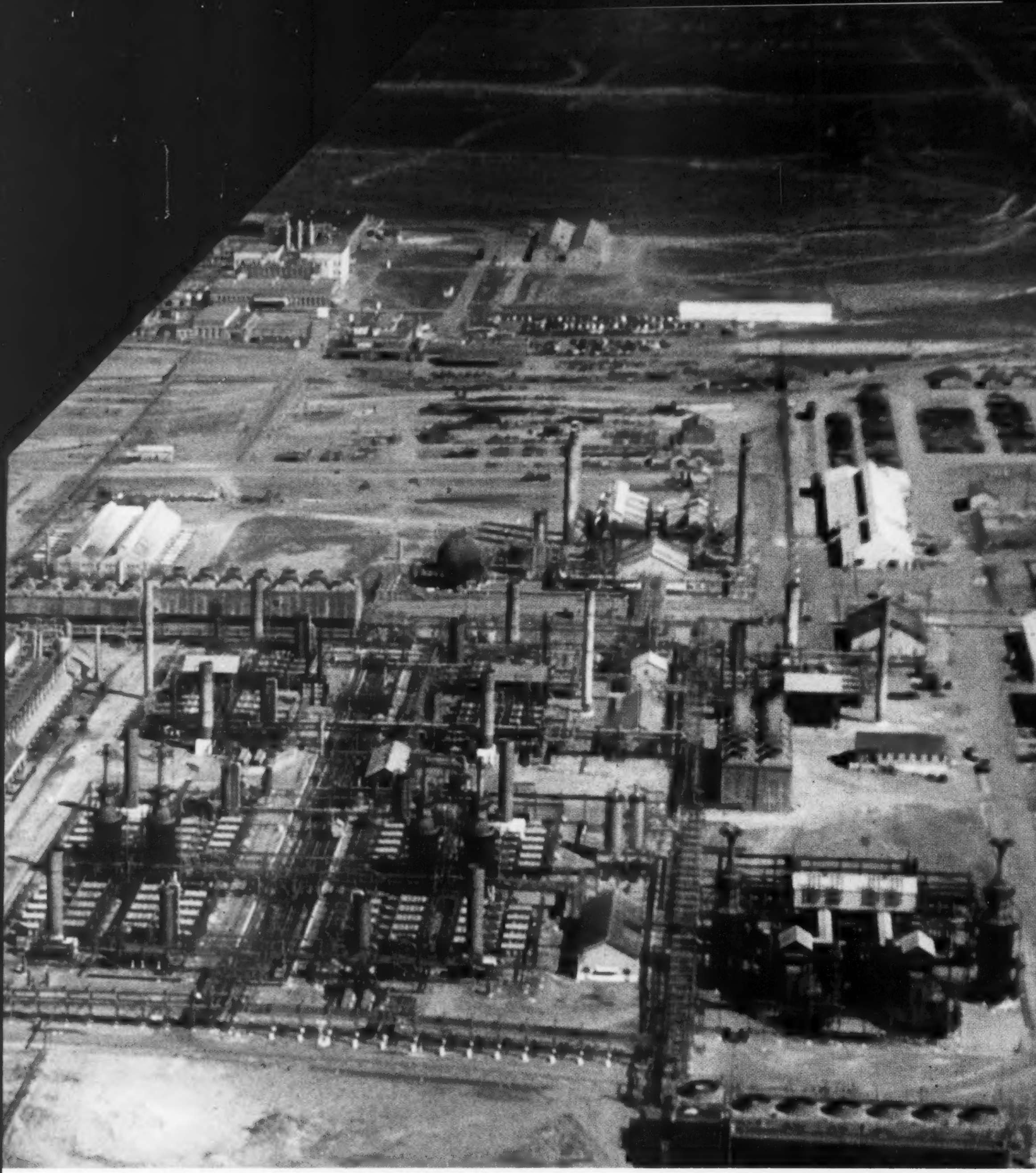

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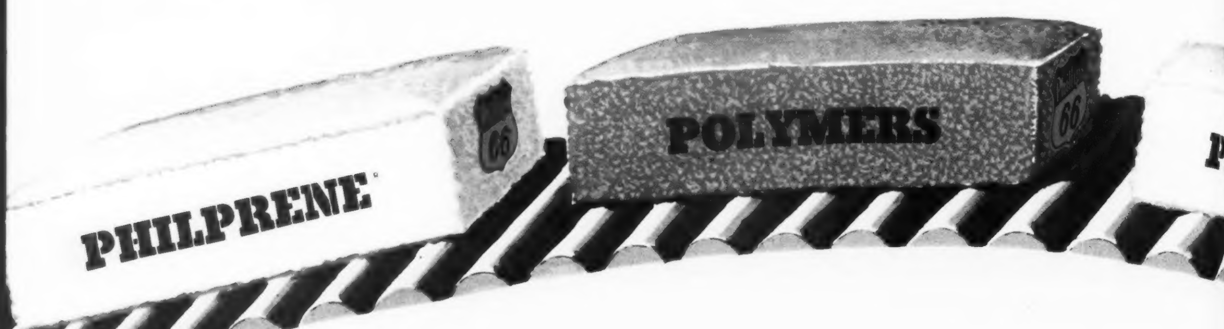

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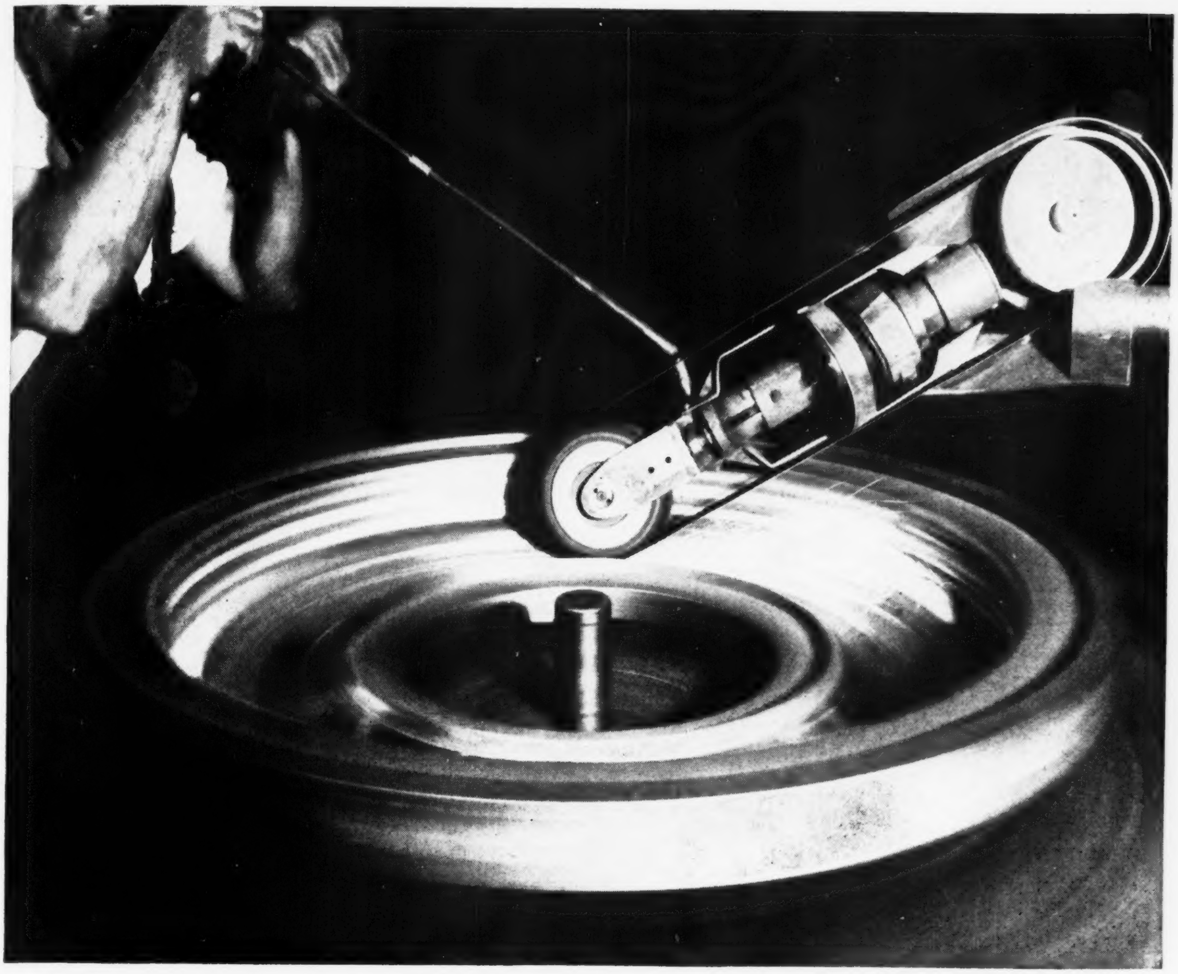

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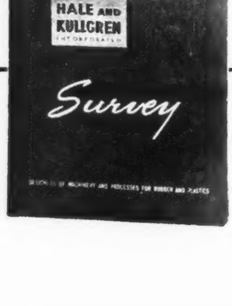

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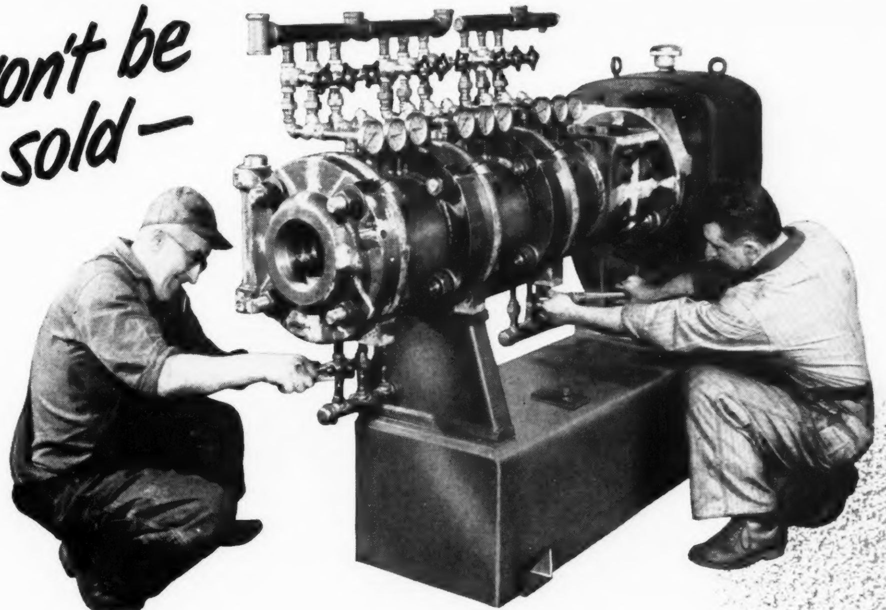

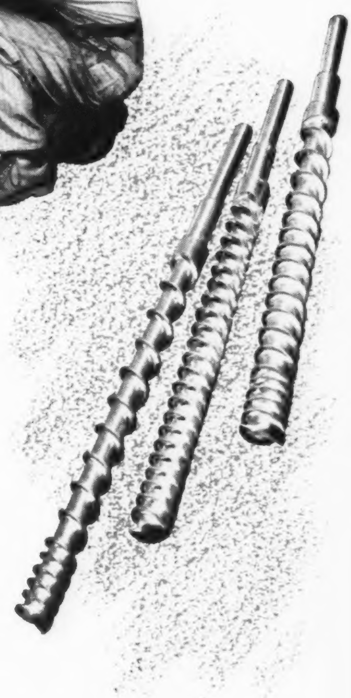

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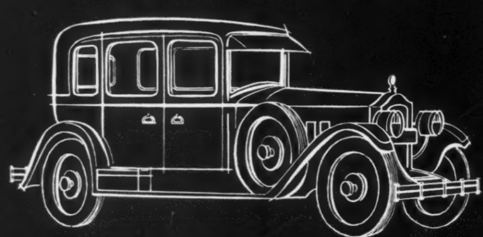

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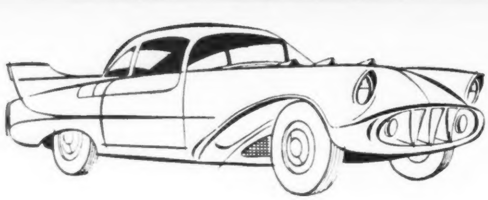

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VOLUME 132 • NUMBER 2 • MAY, 1955

CONTENTS

193 Compounding of Silicone Rubber, III
/*F. L. Kilbourne, Jr., Clinton M. Doede, Keistutis J. Stasiunas*

201 Constant Power Principle in Abrasion Testing
/*E. F. Powell and S. W. Gough*

222 Akron Symposium on Plastic and Rubber Foam-I

222 Rubber and Plastic Foam in the Furniture Industry
/*R. A. Maurer*

222 Rubber and Plastic Foam in the Automotive Industry
/*H. Beckerlag*

225 The Latex Foam Industry
/*T. H. Rogers*

225 Polyvinyl Chloride Foam and Sponge
/*William Manring*

DEPARTMENTS

211 Editorials
213 Meetings and Reports
221 Calendar of Coming Events
News of the Month
226 United States
238 Obituary
240 Financial
242 News from Abroad
248 New Equipment
252 New Materials
256 New Products
258 Book Reviews
258 New Publications
261 Bibliography

MARKET REVIEWS

262 Rubber
262 Reclaimed Rubber
262 Scrap Rubber
264 Cotton Fabrics
264 Rayon
268 Compounding Ingredients

Cover photograph: Transfer of title ceremonies, GR-S copolymer plant, Lake Charles, La., to Firestone Tire & Rubber Co., April 22, 1955. Left to right: Joseph Thomas, Firestone; Disposal Commission executive director, Eugene Holland; J. E. Trainer, Firestone; Commission chairman, Holman D. Pettibone; Commissioner Everett R. Cook; and Commissioner Leslie R. Rounds

RUBBER WORLD

MAY, 1955

Compounding of Silicone Rubber, III[1]

By F. L. KILBOURNE, JR., CLINTON M. DOEDE, and KEISTUTIS J. STASIUNAS

The Connecticut Hard Rubber Co., New Haven, Conn.

Antioxidants have been shown to decrease excessive cross-linking of silicone rubber caused by the use of alkoxy-coated silica filler.

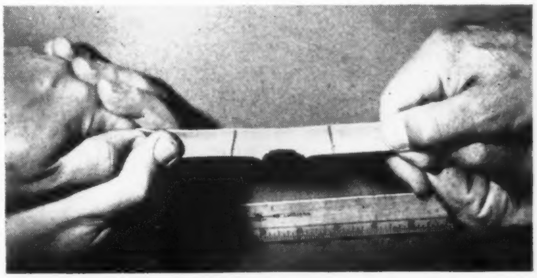
The molecular weight of the silicone rubber used with alkoxy-coated silica should be greater than 400,000 in order to provide high tensile strength vulcanizates, either in the presence or absence of peroxide vulcanizng agents.

AN EARLIER study[2] revealed that a very fine silica,[3] suitably treated so that it is organophilic and hydrophobic, confers upon silicone rubber, in which it is dispersed, the highest tensile strength and elongation that have been reported to date. During the course of that investigation it was found that one variety of this type of filler, formerly known as GS199S Hydrophobic Silica, exerts not only extraordinary reinforcing qualities, but also contributes cross-linking.

In cases where the oven curing is carried out at temperatures above 300° F., the cross-linking proceeds in a very short time to a point where the original rubber-like properties disappear. The same phenomenon occurs, although at a much reduced rate, when curing or aging is carried out at 300° F. for extended periods of time. Short-time air-oven cures at 300° F. of stocks compounded with 50 parts of the silica per 100 parts of dimethyl silicone rubber, and vulcanized with 0.5 to 1.5 parts of benzoyl peroxide, result in tensile strengths of 1850 to 2100 psi. and elongations of 850 to 950%. There can be little doubt that comparison of such data with the corresponding properties of silicone rubber compounds currently used indicates that superior reinforcement is possible.

Silicone products reinforced with alkoxy-protected silica are currently available under the trade names Cohrlastic[4] 400 and Cohrlastic 600.

[1]Presented before the Division of Rubber Chemistry, A. C. S., Louisville, Ky., Apr. 16, 1954.
[2]*Ind. Eng. Chem.*, 45, 1297 (1953).
[3]GS199S Hydrophobic Silica and Du Pont Fine Silica, now known as Valron. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
[4]Trade mark of Connecticut Hard Rubber Co.



Resistance to tear of Cohrlastic HT silicone rubber. The above strip was nicked with a razor blade and then stretched about 100% and photographed

It is one of the objects of this paper to emphasize the second function of alkoxy-protected, hydrophobic silica: namely, its effect on the cure of silicone rubbers, and to indicate ways in which it may be controlled. Another object is to point out that maximum physical properties are obtained with this new type of silica and silicone rubber when the rubber selected has a molecular weight greater than about 400,000.

Effect of Special Silicas on Cure

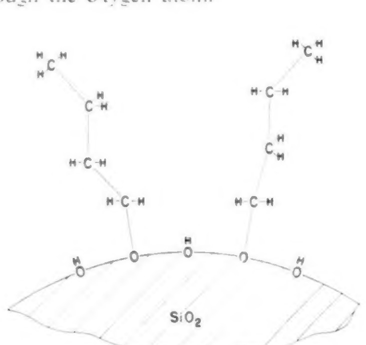
An example of the degree to which alkoxy-protected silica affects the state of cure of silicone rubber is shown in Figure 1. The tensile strength and elongation of 25-volume mixes, with and without the addition of 1% of benzoyl peroxide, are shown at various times and tem-

peratures of cure. In the absence of peroxide, optimum properties are obtained with a 24-hour cure at 300° F.; with 1% of peroxide, one hour to six hours at 300° F. develops optimum properties. In either case, further heating at 300, at 450, or at 480° F. causes a rapid drop in elongation, which in turn results in lower tensile strengths. The phenomenon is obviously one of overvulcanization.

The tensile strength and elongation of two commercially available silicone compounds are also shown in Figure 1. At least one of these compounds contains an aerogel type of silica. Although not so strong or so extensible as the silicone compounds made with special silicas, both of these commercial compounds resist overcuring or oxidative aging at 480° F. quite well.

The vulcanization of silicone rubber with this unique type of silica is unlike the stiffening effect observed with uncoated silicas. These latter silica fillers are known to absorb silicone rubber slowly into the interstices of their porous structure. This "wetting" phenomenon, physical in nature, accounts for the observed thixotropy which occurs when mixtures of such silicas and silicone rubber are stored. Although such uncoated fillers have been observed to show a slight improvement in elongation and tensile strength when silicone rubber is heated with them in the absence of added peroxides, the degree of cross-linking effected by them is not great.

The alkoxy-protected silica used here contained about 14% of organic content, removable by heating in air at 250° C. The protective alkoxy coating consisted essentially of butoxy groups bonded to the silica particles through the oxygen atom.



The butoxy-coated silica loses the butoxy groups through oxidation when heated in air, which suggests that the same reaction occurs when the silica-rubber mixture is heated in air in an oven at 300° F. or higher. It is not clear at this time what the reaction may be. The fact that the cross-links that form are strong is evidenced by the extremely high elongations and tensile strengths that are observed. The longer the heating, the stiffer the vulcanizate, indicating that continued cross-linking occurs. The higher the temperature of heating, the more advanced the state of cure; as shown above, heating at 450° F., or higher, advances the cure rapidly to a brittle stage.

The facts indicate that a chemical reaction resulting in the bonding of silica to rubber occurs concurrently with the oxidation of butoxy groups at the surface of the silica substrate. This reaction causes vulcanization in the air-oven curing process, which continues during aging at elevated temperatures. Consequently it has been stated[5] that this type of silica is suitable for use with silicone products at a maximum service temperature of 300 or 350° F. Our work shows that antioxidants will reduce the overvulcanization which occurs during high-temperature aging so that the maximum service temperature is raised to 400-450° F.

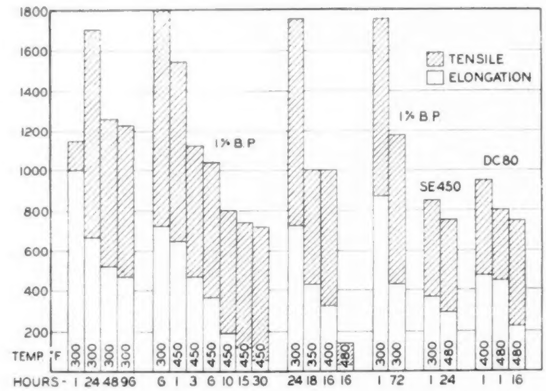


Fig. 1. Effect of long cures on silicone rubber compounds containig alkoxy-protected silica

The Effect of Antioxidants on Vulcanization with Silica

When the speed of oxidation of the butoxy coating is controlled, it follows that the tendency toward overcuring of butoxy-coated silica recipes is also controlled. To demonstrate this point, experiments have been conducted with many antioxidants which have been used in the rubber and oil industries. The use of some of these which appear to have a moderating influence on the overcuring (or oxidation) of butoxy-coated silica recipes is shown below.

As will be pointed out later, the highest tensile strengths and elongations obtainable through the use of vulcanization with butoxy-protected silica are observed when the average molecular weight of the rubber exceeds certain minimum limits. Experiments with antioxidants were started before this fact was fully appreciated. The lower tensile strengths reported in Tables 1 and 2 were caused by the use of low-molecular-weight samples of dimethyl silicone rubber.

Another obvious factor which has a tendency to cause low tensile strengths and elongations is inadequate mixing. The preferred procedure is to mix one day and remill the next so as to permit optimum wetting of macro-agglomerates.

The curing and aging temperatures involved, 300 to 480° F., are so high that volatilization and migration of antioxidants can hardly be avoided. Volatilization can be observed visually with diphenylamine. This antioxidant exerts considerable protection at 300° F., but at higher temperatures it is evaporated, and the dark purple slab becomes amber-colored. Logically then, the best antioxidants for controlling the high-temperature

[5] India RUBBER WORLD, 129, 481 (1954).

aging of alkoxy-protected silica recipes are those with high subliming or boiling points. Because of volatilization, too, it is desirable to keep the slabs as far from each other in the oven as possible and to introduce fresh air continually. The curing (or aging) oven used in this work was a Despatch oven[6] with a Wheelco control. The heating chamber was 37 by 19 by 25 inches.

TABLE 1. EFFECT OF CONCENTRATION OF DIPHENYLAMINE ON CURING DIMETHYL SILOXANE RUBBER WITH GS199S SILICA

	Diphenylamine—Parts per 100 of Rubber			
	None	3	7	10
After curing 12 hours at 300° F.				
Tensile, psi.	1400	1300	1380	1200
Elongation, %	800	825	825	750
Shore hardness	67	57	61	56
Tensile product x 10^{-3}	1120	1070	1140	900
After aging 4 hours at 480° F.				
Tensile, psi.	730	850	880	930
Elongation, %	250	425	425	525
Shore hardness	82	72	77	72
Tensile product x 10^{-3}	182	361	374	488

Effect of Concentration of Diphenylamine

Table 1 shows the effect of increasing percentages of diphenylamine in a recipe containing 100 grams of a dimethylsiloxane rubber and 56 grams (25 volumes PHR) of GS199S Hydrophobic Silica. The press cure was 15 minutes at 250° F., and the oven cure, 12 hours at 300° F. The aging (or postcuring) was carried out for an additional four hours at 480° F.

The use of diphenylamine not only increased the tensile strength slightly after aging at 480° F., but doubled the elongation and prevented excessive hardening. As a result, the tensile product after aging was 170% greater when 10 parts of diphenylamine were present in the original slab. Although the effect of the antioxidant is evident, it was found at the conclusion of the test that all of the diphenylamine had disappeared. This is a good example of the temporary high-temperature protection afforded by a volatile antioxidant.

Comparison of Antioxidants

Table 2 shows a comparison of typical antioxidants, including secondary arylamines, substituted hydroquinone ethers, and a trisubstituted phenol. Three series of tests are condensed in this table; so only limited cross-comparisons are permissible.

The data clearly prove the effectiveness of all of these materials in maintaining superior tensile strength and elongation for periods of more than a week at 300° F. and for 20 hours at 450° F. In tests run 177 hours at 300° F. hydroquinone monobenzyl ether was outstanding. A 100% improvement was observed in both tensile strength and elongation, as compared with a control containing no protective additive. Further tests at 450° F. showed the hydroquinone monobenzyl ether to be superior to other hydroquinone ethers.

Use of Antioxidants in Peroxide-Cured Compounds

Although alkoxy-protected silica has cross-linking propensities which make it unnecessary to use benzoyl peroxide in order to vulcanize the rubber, several advantages are gained through the use of small percentages of this material.

The press-cure for a silicone rubber stock containing benzoyl peroxide will vary from 10 to 30 minutes at temperatures from 210 to 300° F., depending on the complexity of the shape to be molded, the cross-sections involved, and the particular type of stock. Longer cures or higher temperatures in the press will sometimes cause reversion of the product under the influence of the benzoic acid by-product of the vulcanization reaction.

Molding of an ASTM[7] rubber test slab is normally carried out at 250 to 260° F. for 15 to 20 minutes. Without peroxide, however, it is not practical to mold an alkoxy-protected stock in such a short time. Distortion occurs when the piece is removed from the mold. In order to obtain a satisfactory slab without peroxide, a cycle of 30 minutes at 300° F. is required. Although this cure is not excessive for experimental evaluations, the translation of such a molding cycle to a heavy cross-section or complex molding is not practical.

The addition of small percentages of benzoyl peroxide to formulations containing alkoxy-protected silica is, therefore, preferable to dependence on the vulcanization effect of the silica alone. Higher physical properties are obtained even after press-curing when peroxides are used. In the absence of peroxide, optimum tensile properties are obtained only after air-oven curing for approximately 24 hours at 300° F.

Antioxidant Addition during Two-Step Cure

Antioxidants, which have a stabilizing influence on the vulcanization reaction of alkoxy-protected silica, are incompatible with benzoyl peroxide. It is not practical to try to use both peroxide and antioxidant in the same recipe. In order to demonstrate one manner in which both peroxide and antioxidants can be used, experiments were carried out in which small proportions of peroxide were added in order to produce high initial physical properties through press-curing for 10 minutes at 250° F. The slabs were then soaked in a solution of antioxidant for a period of time sufficient to permit migration of the antioxidant into the swollen vulcanizate. After removal of the slab from the solution and evaporation of the solvent, air-oven curing was continued. Hydroquinone monobenzyl ether was the antioxidant used.

The amount of swelling and, therefore, the amount of antioxidant absorbed were less when higher concentrations of benzoyl peroxide were used. The solution used consisted of 20 parts of hydroquinone monobenzyl ether in 10 parts of acetone and 90 parts of benzene. The soaking period was 15 hours at room temperature. The amount of antioxidant absorbed by the slabs was determined by the gain in weight of the slabs as compared with a control which was soaked in the solvent only. Typical results obtained in this manner are shown in Table 3.

It will be observed from Table 3 that the initial

[6]Despatch Oven Co., Minneapolis, Minn.
[7]"ASTM Standards on Rubber Products, December 1954," p. 5. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

TABLE 2. EFFECT OF VARIOUS TYPES OF PROTECTIVE AGENTS IN SILICONE RUBBER CURING

	Parts Filler							
Time of heating at 300° F. (hours)		16	65	86	177	190		
450° F. (hours)							6	20
Protective agent (5 PHR)								
None	45							
Tensile, psi.		1000	1075	1000	575	610		
Elongation, %		700	625	475	300	225		
Shore hardness		67	63	75	73	80		
Tensile product x 10^{-3}		700	670	475	172	137		
Hydroquinone monobenzyl ether	45, 56							
Tensile, psi.		960	1370	1180	1225	920	1470	1040
Elongation, %		875	800	625	630	400	875	450
Shore hardness		65	60	76	65	79	62	78
Tensile product x 10^{-3}		840	1100	738	770	368	1290	470
2,6-Di-tert-butyl-4-methylphenol	45							
Tensile, psi.		1000	1250	1050	890	700		
Elongation, %		750	725	725	425	350		
Shore hardness		72	58	80	75	85		
Tensile product x 10^{-3}		750	935	760	380	245		
p-Isopropoxydiphenylamine	45							
Tensile, psi.		1160		1080		780		
Elongation, %		725		575		350		
Shore hardness		71		73		75		
Tensile product x 10^{-3}		840		620		273		
Diphenylamine	45							
Tensile, psi.		950		930		660		
Elongation, %		725		600		325		
Shore hardness		65		76		83		
Tensile product x 10^{-3}		690		560		214		
2,5-Di-tert-butylhydroquinone	45							
Tensile, psi.			925		770			
Elongation, %			650		475			
Shore hardness			62		68			
Tensile product x 10^{-3}			600		366			
2,5-Di-tert-amylhydroquinone	45							
Tensile, psi.			1250		940			
Elongation, %			725		550			
Shore hardness			58		65			
Tensile product x 10^{-3}			905		515			
Hydroquinone dibenzyl ether	56							
Tensile, psi.							1140	615
Elongation, %							775	225
Shore hardness							62	75
Tensile product x 10^{-3}							885	138
Hydroquinone dimethyl ether	56							
Tensile, psi.							1150	760
Elongation, %							700	300
Shore hardness							64	77
Tensile product x 10^{-3}							805	228
Hydroquinone monomethyl ether	56							
Tensile, psi.							1120	770
Elongation, %							600	350
Shore hardness							64	76
Tensile product x 10^{-3}							675	270

TABLE 3. USE OF ANTIOXIDANT AFTER PEROXIDE CURE*

Benzoyl Peroxide P.H.R.	First Cure Hrs. @ 300° F.	Antioxidant† Added % Wt. Gain	Second Cure Hrs. @ 450° F.	Tensile, Psi.	Elongation, %	Hardness
0	5	0	0	415	975	45
0	5	0	22	370	25	95
0	5	6	22	1150	500	70
0.2	0.5	0	0	1230	800	55
0.2	0.5	3.5	5	1410	600	65
0.2	0.5	3.5	11	1370	500	74
0.2	0.5	3.5	22	1050	300	76
0.2	0.75	0	0	1270	925	50
0.2	0.75	4.6	63	860	100	87
0.8	3.5	0	0	1750	775	60
0.8	3.5	2	22	900	250	80

*Recipe 100 parts SE-76; 50 parts alkoxy-protected silica; peroxide and antioxidant as shown. †Hydroquinone monobenzyl ether.

tensile strength and hardness increased and elongation decreased as the amount of benzoyl peroxide was increased. Likewise, the amount of antioxidant picked up by the slab decreased as the cure tightened through the use of more peroxide. The second line of the table shows the low tensile and elongation and high hardness when no antioxidant was present with cures carried out at 450° F.

A substantial improvement was observed when six parts of hydroquinone monobenzyl ether were added by the diffusion process. This method of introducing the antioxidant makes it possible to have high initial tensile and elongation and a fairly high degree of heat stability at 450° F. in the same recipe. Slabs protected in this way still remain rubbery after as many as 63 hours at 450° F.

In this way, higher average physical properties can be maintained through long service at high temperature. This technique allows the use of alkoxy-coated silica reinforced and vulcanized stocks at service temperatures up to 450° F.

In another experiment 27 antioxidants were examined by the same technique. The base stock comprised 100 parts of SE-76[8] (molecular weight 800,000), 50 parts of Fine Silica, and 0.4-part of benzoyl peroxide. The press-cure was 10 minutes at 250° F. Ovencures were 24 hours at 300° F. The average results for 27 test strips are given in Table 4.

The antioxidants were dissolved in benezene in 15% concentrations. Test strips were soaked in the solutions for 16 hours and were then removed and dried. It was necessary to add acetone to the solutions of hydroquinone monobenzyl ether and N, N′-di-β-naphthyl-p-phenylene diamine to dissolve the antioxidants completely.

The test strips were suspended in individual gallon cans with loose-fitting covers. A few holes in the covers permitted evaporation of the antioxidants. This attempt to reduce migration was only partially successful since traces of antioxidant were detected in a can containing a control slab during the early stages of the cure. All cans were withdrawn from the oven at intervals of two, four, eight, and 20 hours for removal of strips and introduction of fresh air.

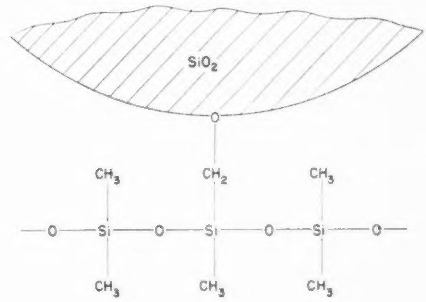
In Table 4, the data have been tabulated in descending order of effectiveness of the protective agents. Stock numbers are shown. Stock numbers 4064 through 4080 were cured as one group, and 4081 through 4091 as another. One control stock (4091) was aged with the second group of stocks. Another control stock (4092) was aged by itself in the same oven, but with no antioxidant present. Tests after a short and a long aging period are given in Table 4. The maximum tensile cure and the 20-hour cure at 450° F. are reported here.

Antioxidant Effectiveness Evaluated

The degree of protection obtained in the manner described is dependent on the state of initial cure, the solubility and volatility of the additive, and the specific action of the individual additives. In the superior group of materials, two hydroquinone alkyl ethers, a primary arylamine, a secondary arylamine, an aryl-substituted phenylene diamine, a trialkylphenol, and two dihydroxynaphthalenes are found. Other hydroquinone alkyl ethers, mixtures of diamines and arylamines, and an alkyl dihydroxy phenol appear to have been moderately effective. Most of these were effective for two to eight hours at 450° F., but allowed the elongation to fall below 250% in the 20-hour cure. The less effective antioxidants include primary and secondary amines, which were probably too volatile, and a cresol which swelled and depolymerized the rubber.

It appears that high-boiling phenols, hydroquinones, naphthalenediols, amines, and diamines are active in retarding overcure and aging, both of which, in this system, are caused by oxidation. It is not clear at this time whether the additives absorb oxygen, thus preventing it from attacking the alkoxy group on the silica, or whether the antioxidant substitutes for the silicone rubber in reaction with the oxidized silica.

If it is assumed that the oxidized silica becomes attached to the silicone rubber molecule through an oxidized methyl side chain, thus forming a cross-link from rubber to filler particle, it is possible to explain the vulcanization.



There are, however, many —OR groups on the surface of each silica particle. The part played by oxygen would be to create free radicals capable of attacking the methyl side chains. The antioxidant may act simply as a scavenger, picking up the oxygen before it can bring about the formation of free radicals, or it may react with such free radicals, nullifying their effect. On the other hand, the antioxidants may react with the methylene group and/or with the oxidized silica to prevent the formation of a cross-link.

Elucidation of the mechanism of both the vulcanization and protection of silicone rubber in the presence of butoxy-coated silica and oxygen must await further study. For practical purposes it may be concluded that the combined reinforcement and vulcanization of the rubber by the new silica will find greater use if the latter is controlled by means of antioxidants.

Effect of Molecular Weight of Silicone Rubber on Vulcanization with Silica

Manufacturers of silicone rubber go to considerable trouble to purify the difunctional dimethyldichlorosilane. This material, the basic monomer in the production of silicone elastomers, is obtained by the Grignard method

[8]General Electric Co., silicone products department, Waterford, N. Y.

TABLE 4. COMBINED EFFECT OF ANTIOXIDANTS AND PEROXIDE CURE.

	Aging Periods Hrs. @ 450° F.	Tensile, Psi.	Elongation, %	$TP \times 10^{-3}$	M400, Psi.	Hardness
Initial cure 24 hours at 300° F.—0.4% benzoyl peroxide		1277	876	1117	284	54
4064 Hydroquinone dimethyl ether	4	1520	625	970	820	68
	20	1056	375	396	..	84
4065 Phenyl-α-naphthylamine	4	1580	800	1260	545	60
	20	1180	450	530	1000	75
4069 Diphenylamine	4	1550	625	970	750	65
	20	835	225	440	..	85
4071 2,5-Di-tert-butylhydroquinone	2	1380	775	1070	435	62
	20	950	350	332	..	72
4074 Hydroquinone monomethyl ether	8	1400	800	1120	435	64
	20	1220	550	670	860	68
4078 1,5-Dihydroxynaphthalene	4	1550	850	1320	440	60
	20	1000	450	450	950	78
4080 1,4-Dihydroxynaphthalene	4	1470	800	1175	420	58
	20	1160	550	640	870	75
4082 2,6-Di-tert-butyl-p-cresol	4	1650	800	1320	380	66
	20	930	250	232	..	82
4084 N,N'-Di-β-naphthyl-p-phenylene diamine *(a)*	2	1390	800	1130	394	65
	20	1000	400	400	1000	85
4089 N,N'-Di-β-naphthyl-p-phenylene diamine *(b)*	2	1390	850	1180	338	58
	20	1000	475	475	825	75
4067 Akroflex C *(c)*	2	1410	775	1090	570	62
	20	850	250	212	..	89
4068 Hydroquinone dibenzyl ether	4	1550	825	1279	520	62
	20	800	150	120	..	89
4072 Styphen I *(d)*	4	1380	650	900	600	70
	20	735	100	74	..	88
4079 Hydroquinone benzyl ether	4	1310	700	915	470	62
	20	760	250	190	..	84
4085 2,5-Di-tert-amylhydroquinone	4	1300	700	910	630	68
	20	720	150	108	..	85
4087 4-tert-butylcatechol	4	1610	800	1290	505	75
	20	800	200	160	..	..
4088 Thermoflex A *(e)*	2	1270	750	950	475	72
	20	665	200	133	..	85
4092 Control #2 (aged alone)	2	850	375	320	..	75
	20	735	150	110	..	77
4066 N,N'Diphenylethylene diamine	2	1070	550	590	310	75
	20	660	75	47	..	90
4070 Stabilite White *(f)*	4	900	725	650	515	63
	20	490	75	37	..	90
4073 Santoflex B *(g)*	2	430	100	43	..	80
4075 Akroflex C-D *(h)*	2	1370	700	960	560	69
	20	750	100	75	..	90
4076 BLE *(i)*	2	1050	600	630	690	72
	20	670	50	34	..	90
4077 p-Isopropoxydiphenylamine	2	1250	650	810	650	69
	20	780	75	59	..	90
4081 N,N'-Diphenyl-p-phenylene-diamine	4	975	450	440	900	80
	20	645	100	65	..	90
4083 N,N'-Di-o-tolylethylene-diamine *(j)*	2	880	600	528	550	76
4086 Antioxidant 2246 *(k)*	2	745	700	520	320	75
4090 6-Tert-butyl-m-cresol *(l)*	4	430	675	36	312	52
	20	170	25	4	..	77
4091 Control (aged with second group)	4	1180	750	885	388	60
	8	1190	750	890	500	64
	20	440	50	22	..	75

(a) R. T. Vanderbilt Co., 230 Park Ave., New York, N. Y.
(b) B. F. Goodrich Chemical Co., Rose Bldg., Cleveland, O.
(c) 35% diphenyl-p-phenylene diamine and 65% phenyl-α-naphthylamine. (Du Pont.)
(d) Tris-(α-methylbenzyl)-phenol mixture. (Dow Chemical Co., Midland, Mich.)
(e) 25% Bis-(p-methoxyphenyl)-amine, 25% N,N'-diphenyl-p-phenylene diamine and 50% phenyl-β-naphthylamine. (Du Pont.)
(f) C. P. Hall Co., Akron, O.
(g) Too brittle to test at 20 hours. Reaction product of acetone and p-aminobiphenyl. (Monsanto Chemical Co., St. Louis, Mo.)
(h) 35% N,N'-Diphenyl-p-phenylene diamine and 65% phenyl-β-naphthylamine. (Du Pont.)
(i) 65% complex diarylamine-ketone aldehyde reaction product and 35% N,N'-diphenyl-p-phenylene diamine. (Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.)
(j) Too brittle to test at 20 hours.
(k) Too brittle to test at 20 hours. Bis-(2-hydroxy-3-tert-butyl-5-methylphenol)-methane. (American Cyanamid Co., Bound Brook, N. J.)
(l) Depolymerization evident.

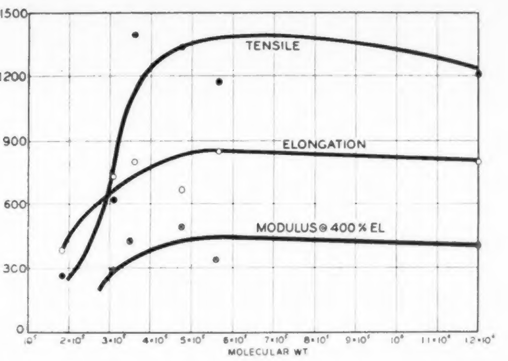


Fig. 2. Effect of molecular weight of silicone rubber in compound containing 25 volumes of Fine Silica and cured 48 hours at 300° F.

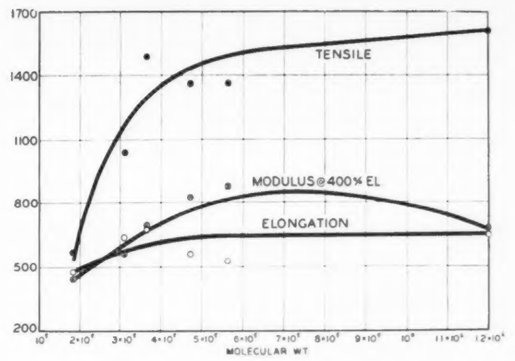


Fig. 3. Effect of molecular weight of silicone rubber in compound containing 25 volumes of Fine Silica and cured 8 hours at 300° F. with 2% benzoyl peroxide

or by the reaction of methyl chloride in the vapor phase with silicon heated to about 300° C. The production of 100% difunctional material in either case is not possible, although the Grignard method is probably more satisfactory from the standpoint of purity of product. The monofunctional trimethylmonochlorosilane, which acts as a chain stopper, and the trifunctional methyltrichlorosilane, which leads to three-dimensional growth or branching, must be fractionally distilled from the difunctional material.

There are many other factors requiring control in the preparation of silicone rubber of uniform molecular weight with negligible chain branching. Variation in the tensile strength of vulcanizates obtained by reinforcing silicone rubber with alkoxy-protected silica has been found to be caused by variation in the molecular weight of the rubber itself.

The method of determining average molecular weights was based on the viscosity of dilute solutions, as described by Flory *et al.*[9] Dilute solutions of each polymer were made at several concentrations in methyl ethyl ketone. Their viscosity was determined at 30° C., with a standard Ostwald viscosimeter, at concentrations of 0.4 to 0.05 g/100 ml. Values of the intrinsic viscosity were obtained by extrapolation of the specific viscosity-concentration ratio to infinite dilution.

These data were then applied to the Staudinger equation:

$$[\eta] = KM^{a} \quad (1)$$

where "M" is the molecular weight, and "K" and "a" may be considered empirical constants for a given polymer-solvent system at one temperature. The values of the constants "K" and "a" for polydimethylsiloxane elastomers were found by Flory and his co-workers, who related the intrinsic viscosities to molecular weights determined osmometrically.

At 30° C. the empirical equation representing the intrinsic viscosity of polydimethylsiloxanes in methyl ethyl ketone is as follows:

$$\log \eta \text{ MEK } 30^\circ \text{ C.} = -3.318 + .55 \log M \quad (2)$$

[9] Flory, Mandelkern, Kinsinger, Schultz, *J. Am. Chem. Soc.*, 74, 3364 (1952).

Four silicone rubber samples supplied by one manufacturer and two by another, covering a wide range in molecular weight, served to demonstrate the effect of molecular weight of the silicone rubber on the tensile strength. The molecular weights were calculated from Equation 2, above, using intrinsic viscosities at 30° C., as shown. The data are reported in Table 5.

TABLE 5. MOLECULAR WEIGHT OF POLYDIMETHYLSILOXANES

Sample	[η] MEK 30° C.	Molecular Weight
A	0.380	187,000
B	.505	309,000
C	.533	345,000
E	.636	468,000
D	.700	575,000
F	1.017	1,120,000

These samples of silicone rubber were compounded with 25 volumes of Fine Silica. In one series of tests, 2% of benzoyl peroxide was used, and in another the peroxide was omitted. The results are shown in Figures 2 and 3. The elongation, modulus, and tensile strength all increase with increase in molecular weight.

When benzoyl peroxide is present, the optimum tensile strength is reached in an oven in about one hour at 300° F. and remains high for several hours as the modulus increases and elongation decreases. The eight-hour cure was selected for representation in Figure 2, without peroxide.

In the absence of benzoyl peroxide, optimum tensile strength is not reached until a cure of 24 to 48 hours at 300° F. has been effected. After a cure of 48 hours at 300° F., which was selected here, the elongation was about 200% higher than that obtained after a cure of eight hours at 300° F. when peroxide was used. The modulus at 400% elongation was 300 to 400 psi. higher for peroxide cures than for non-peroxide cures.

It is interesting to note that the hardness in neither recipe is affected by variation in molecular weight. Hardness is dependent on the loading of pigment and is not dependent on the molecular weight of the vulcanized polymer. The Shore hardness of the peroxide-free series was 61-64, and that of the peroxide-cure series was 71-75.

Optimum Molecular Weight

What Figures 2 and 3 actually show is that with increasing molecular weight, there is a rapid increase in tensile strength up to a molecular weight of about 400,-000, with both recipes. Silicone rubber of this molecular weight is slightly more viscous than commercially available types, but there appears to be no reason why it could not be made available if required.[10] Some difficulty in mixing and dispersing Fine Silica in very high-molecular-weight rubber may be experienced. However, from the data in Figures 2 and 3 there appears to be no reason for using silicone rubber of average molecular weight over 600,000. It seems possible that a certain minimum viscosity of the rubber is necessary in order to get the proper dispersion which results in optimum properties. All mixings tested in this portion of the work were carried out with attention paid to this point. Seventy-eight-gram batches were mixed for 35 minutes on a Thropp[11] eight- by three-inch laboratory mill.

Discussion

The phenomenon of a reinforcing filler which provides the means of cross-linking the polymer in which it is dispersed is not common. In the absence of a means of control, such a filler would not be useful. In the case of alkoxy-coated silica, the curing activity may be held in check by limiting the service temperature to 300 or 350° F., as has been suggested,[5] or by introduction of protective agents, many of which are well-known antioxidants. These agents lengthen the life of vulcanized elastomer at 300 and 450° F. It may be expected that further research will turn up protective agents or antioxidants which will raise the allowable service temperatures still further.

The reasons why alkoxy-coated silica results in the highest elongations and tensile strengths reported to date are not entirely clear. The authors believe that the extremely fine ultimate particle size, approximately 0.01 μ, is a significant factor. The organophilic nature of the coated particles undoubtedly promotes good wetting of the filler by the silicone rubber.

The high tensile strengths obtained with alkoxy-silica are always associated with high elongations. Excessive cross-linking results in reduced elongation and a reduction in tensile strength. The siloxane molecules have very low forces of intermolecular attraction, and the well-wet silica particles may be considered as physical cross-linking agents which bind the siloxane molecules together, but which allow considerable plastic flow under strain. Plastic flow is evident in the high-tensile, high-elongation test strips of press-cured slabs. The necessity of using moderately high-molecular-weight rubber in order to achieve high tensile strength values is consistent with the idea of a physical vulcanization as the primary cause of the great reinforcement shown by the butoxy-coated silica. A few of the silica aggregates in the process of losing part of their alkoxy groups through oxidation give rise to the chemical bonds which firmly tie the elastomer molecules together to form the vulcanized product. Control of the number of such bonds is the part played by antioxidants.

Further research directed toward an elucidation of the mechanism of this oxidation-vulcanization reaction and its control by means of antioxidants will be necessary. Measurement of the actual number of cross-links formed per unit weight of silica should also prove interesting.

Summary and Conclusions

Earlier work with alkoxy-protected, hydrophobic silica has been extended. It has been found that superior tensile strengths are found in rubbers with molecular weights of approximately 400,000, or higher, where the hydrophobic silica is used.

The hydrophobic silica exerts a persistent curing action, unlike that of peroxides. It has been found possible and practical to retard the vulcanization rate and the overcuring tendency by the introduction of antioxidants. Among the antioxidants discussed are diphenylamine, hydroquinone monobenzyl ether, 2,6-di-tert-butyl-4-methyl phenol, and the ditertiary alkylhydroquinones. This work defines more closely those conditions necessary for silicone rubber to achieve high strength and consequent wider application.

Acknowledgment

The authors acknowledge, with appreciation, the assistance of Aldo DeFrancesco and Miss Anne Larkosh who carried out the molecular weight measurements. Appreciation is expressed to The Connecticut Hard Rubber Co. for permission to publish these results and to the Office of the Quartermaster General which sponsored the earlier investigations that created interest in high-strength silicone rubber.

[10] G-E has made available two special, high-viscosity silicone rubbers for use with Valron, as follows: 81465, general-purpose type; and 81477, low brittle point type.

[11] Wm. R. Thropp & Sons Co., Inc., Trenton, N. J.

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Plans "Cold" Radiation Reactor

A nuclear reactor that can produce large quantities of neutron-free gamma radiation at relatively low cost has been designed by Gamma Corp., Mansfield, Mass., and will be constructed shortly. The reactor will be leased to industrial firms, research institutes, and universities for their studies on the effects of neutron-free gamma radiation on raw materials, processes, and finished goods.

"Cold" radiation, producing property changes in materials without rendering them radioactive, has considerable potential in such fields as rubber, plastics, and textiles, the company declares, and is eventually expected to lengthen the life and increase the strength of these goods. Automobile tires of almost unimagined longevity, for example, are held forth as a possibility.

The reactor design is based on declassified information, and the fissionable material constituting the fuel will be treated as ony other substance of monetary value.

Constant Power Principle in Abrasion Testing[1]

By E. F. POWELL and S. W. GOUGH

Dunlop Rubber Co., Ltd., Fort Dunlop, Birmingham, England

One underlying principle, that of constant rate of energy dissipation at the abrading surface, is proposed as a criterion for comparison of the validity of test design for the many different types of laboratory test in regular use for assessment of wear resistance.

Modification of the Lambourn constant slip machine to make it conform with the constant power principle is described, and the degree of correlation with service data on tires given.

The effects of several major variables on the abrasion loss of rubber tread compounds, when tested with the modified Lambourn machine, are reported, including work on combating stickiness.

Experiments with the Du Pont and U. S. Bureau of Standards abraders, modified to conform to constant power principles, are also reported in this paper.

The relations between work done in mechanically grinding rubber and the energy associated with the bonds which are ruptured in the grinding action are considered. It is suggested that a correlation may exist between abrasion and high-temperature flexibility properties of rubber.

THE assessment of resistance of rubber compounds to abrasion by laboratory methods is such a complex and difficult procedure that it is not surprising that a large variety of different methods has been developed and recommended in various laboratories.

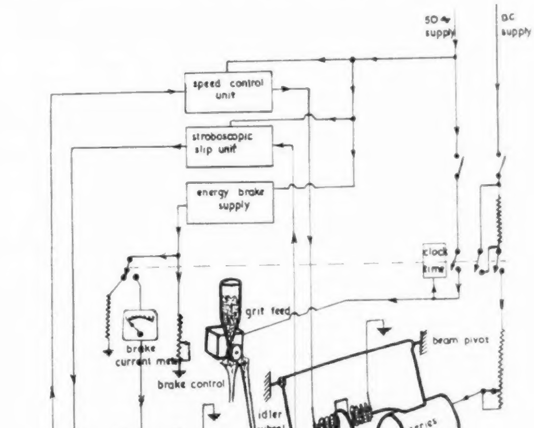


Fig. 1. Schematic diagram of constant-power Lambourn abrasion machine

I. Introduction

Two aspects of the test have received attention:

Reproducibility, which involves accurate control over the dominant factors governing wear so that results can be satisfactorily duplicated on any rubber.

Validity, or the choice of such test conditions that the laboratory order of merit of a series of rubbers is not in conflict with their behavior under service conditions.

Various degrees of emphasis are placed on the necessity of the second of these requirements; the authors' views are that validity is a primary and indispensable factor by which a laboratory abrasion test should be judged.

It is becoming generally accepted that different service conditions are productive of different relative performances between rubbers, and J. M. Buist (1)[2] and others have drawn attention to the need of a range of test conditions to cater for products such as tires, flooring, footwear, or clothing.

The most important application of rubber in industry still remains in treads of tires, in spite of the increasing diversity of other applications of rubber. Tire manufacture still accounts for about 70% of the world's consumption of rubber, and since normal useful life of a tire is governed by wearing out or abrasion, the laboratory testing of resistance to abrasion might be regarded as the most important criterion of fitness for service. It is unfortunate, therefore, that the test proves to be one of the most difficult to carry out in such a way that the results can be used for prediction.

[1] Presented before the Third Rubber Technology Conference, London, England, June 24, 1955.

[2] Numbers in parentheses refer to Bibliography items at end of article.

(For Figs. 2-5, see facing page)

Fig. 2. Original horizontal beam machine. Test piece and abrasive wheel are behind housing in locations indicated by dotted lines

Fig. 3. General view of vertical nip machine

Fig. 4. Vertical nip machine showing test piece and idler pulley

Fig. 5. Control cabinet at rear of machine

This paper concerns the development of a laboratory test intended primarily for assessment of tire tread compounds.

2. History

Many empirical forms of laboratory abrasion testing machine have been devised in the past, usually each concentrating on operation at fixed contact pressures and rubbing speeds as an attempt to simulate idealized service conditions. For example, we have the Akron angle slip machine, Graselli Du Pont machine, Lambourn constant slip machine, B.S.A.T.R.A.[3] machine as those which have been most widely used. A fuller list is given by Buist in his paper (1).

These machines were able to cope, to some extent, with the problem of assessing rubbers when the compounds were relatively few in number and widely different in properties. As compounding techniques progressed, it became increasingly important to differentiate between finer differences of abrasion resistance for the economics of production and service. The need of improving abrasion testing methods became pressing.

Until 1932, Dunlop was using the Lambourn constant slip machine (2) as the best method for abrasion testing of tire tread compounds. By this date, however, the differences between compounds of importance to the company had reduced to well within the test's discriminating power; yet there was service evidence to indicate the existence of real differences in some cases. In this period we frequently obtained inexplicable reversals of evidence in simple repetitions of straight compounding comparisons.

In a private communication another member of the company, G. Bruhat, pointed out the suggestion arising from some results that constant slip alone was an insufficient control criterion for abrasion testing. When considering the lack of agreement between laboratory and road testing of abrasion loss *versus* state of cure, he thought that the power passed through the rubber during abrading must be varying between successive tests.

In the Lambourn machine, adjustments to hold constant slip against any variations during a test were made by adjusting the power absorption in the brake (2). In other words, transmitted power was deliberately altered, but not measured. G. Bruhat pointed out that where tests had been possible with constant brake current throughout the test series on a Lambourn machine, the repetition was very good.

This fact laid the foundation for considering abrading under some form of power control.

3. Need of Power Control in a Laboratory Test

Extending the general view of a laboratory test outlined in the introduction, the same considerations must govern the principles of test design as are applied to the service information from the road. For example, results from differing service conditions are weighted to standard conditions to eliminate road, vehicle, weather, or driving variables. This is equivalent to controlling test-car schedules to specific rates of energy dissipation or power levels.

Controls on the laboratory machines must take care of these factors; yet the test must be short. All abrading actions are complex, but the fierceness of the action can be assessed by considering the energy dissipated at the rubbing faces, whatever the nature of the mechanism of surface removal.

Hence, after the nature of the surfaces to be rubbed together at a selected relative speed has been decided upon, the remaining complex abrasion factors can be standardized by controlling the power transfer of the system.

In other words, abrasion machines should operate under constant power conditions.

The work of the authors on machines designed to operate on this principle has led them to support the view that any existing design of machine is certain to be improved in test performance by introducing energy control or correction. Ira Williams (3) also took a similar view in his original paper on the du Pont abrader.

4. Distribution of Power in Abrasion Machines

In order to cause one surface to abrade another, an input power P_I is necessary immediately prior to the input side of the abrading interfaces. The power is distributed throughout the abrasive/test piece system thusly:

4.1 Both surfaces moving, but having a relative slip velocity

$$P_I = P_R + P_T \qquad (1)$$

4.2 Output surface at rest, slip velocity arising only from the movement of one surface

$$P_I = P_R \text{ (and } P_T = O) \qquad (2)$$

Where P_R = power absorbed into the surface materials as abrasion power and heat loss.

P_T = power transmitted through the interface to appear as work against a load driven by the mechanism.

The Lambourn and Akron angle (4) machines operate as type 4.1; while the du Pont and U. S. Bureau of Standards machines operate as type 4.2.

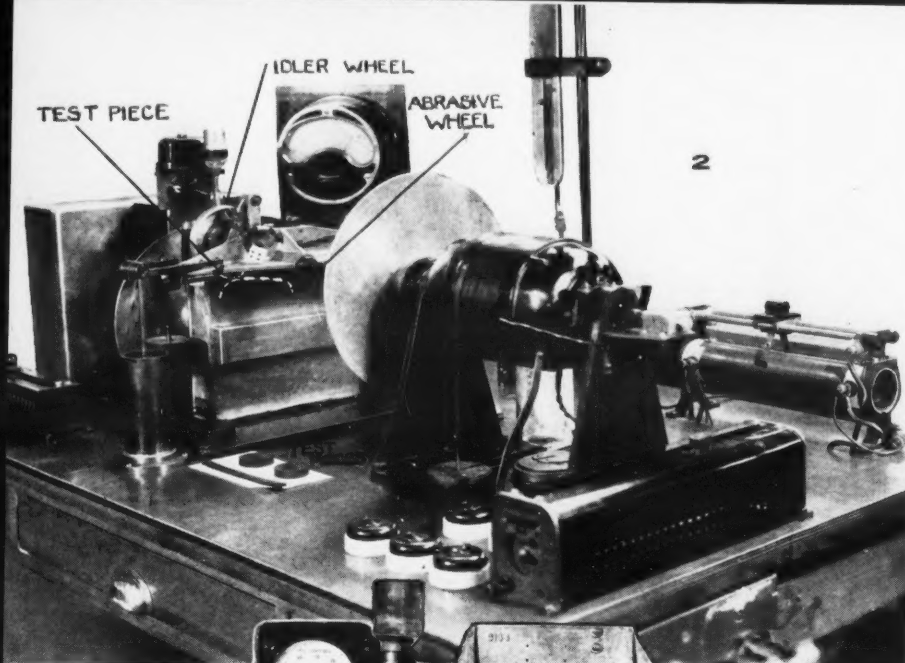
Also in type 4.1, if F = force acting, and V = velocity of output surface, then

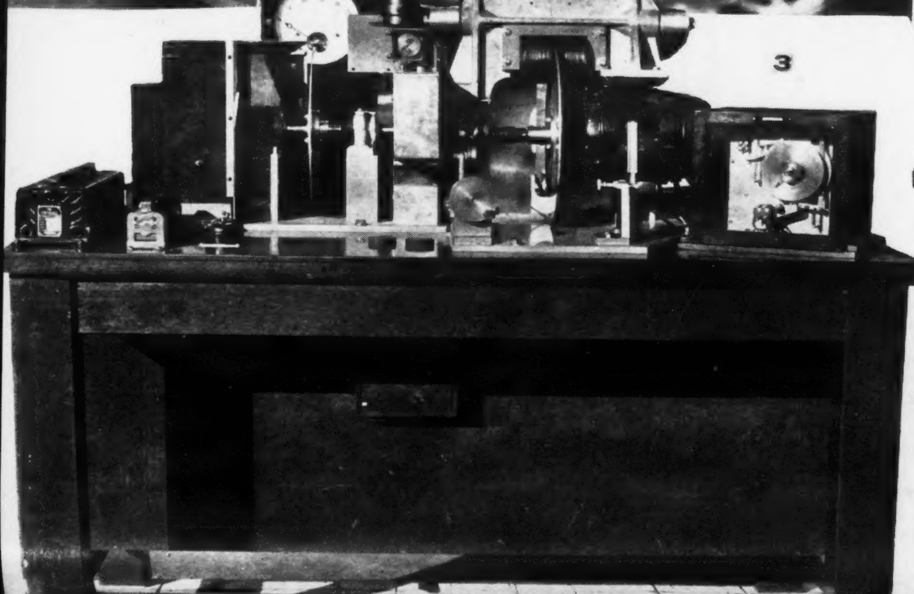
$$F = P_T/V \qquad (3)$$

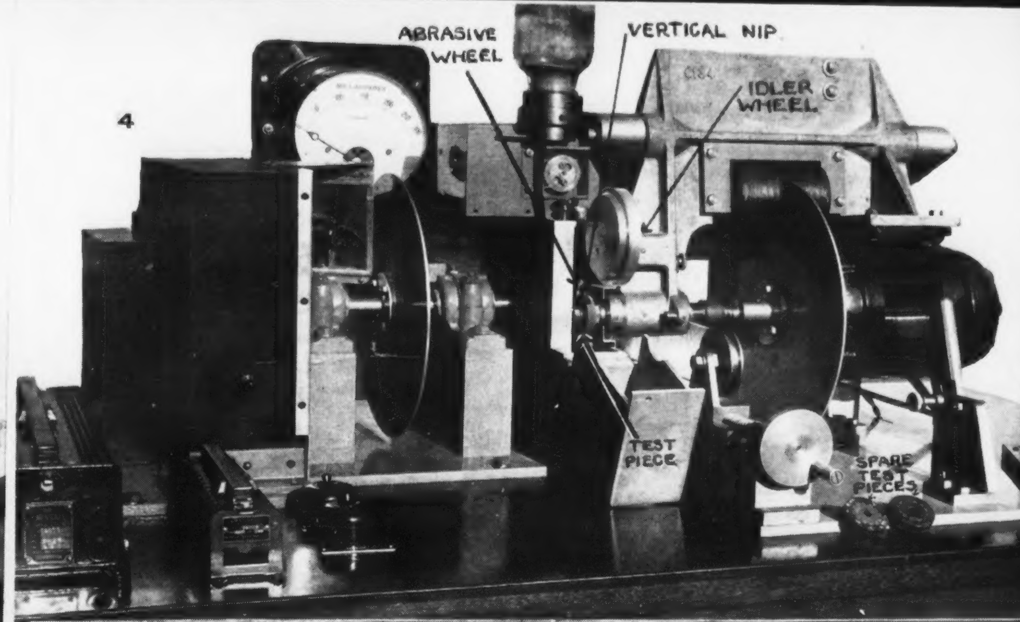
Let v = relative rubbing or slip velocity between the surfaces; then

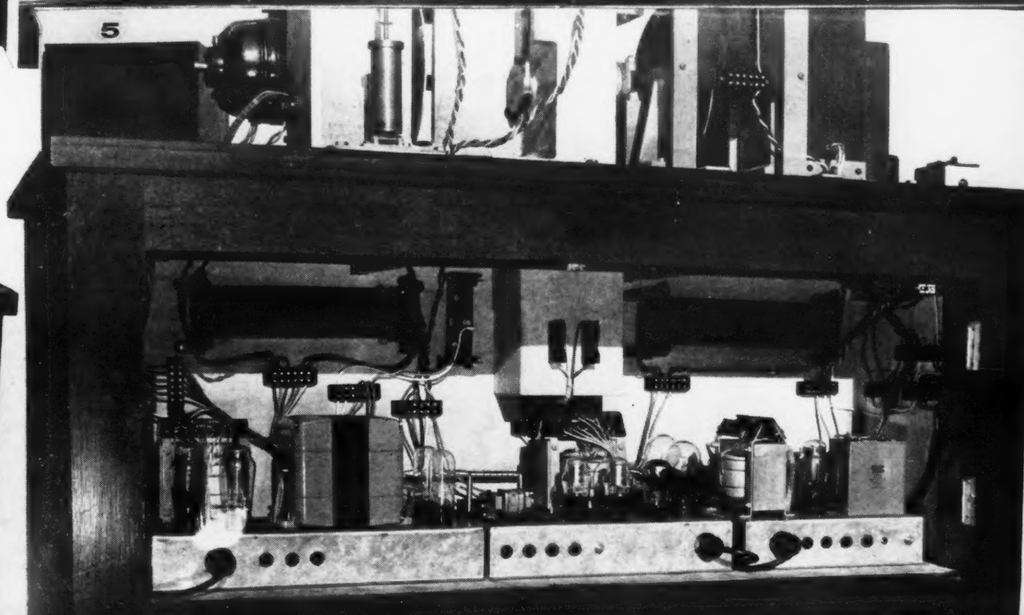
$$P_R = P_I - P_T = F[(V + v) - V] = Fv \qquad (4)$$

[3] Boot, Shoe & Allied Traders Research Assn. See *Trans. Inst. Rubber Ind.*, 21, 375 (1946).


TEST PIECE
IDLER WHEEL
ABRASIVE WHEEL
2


3


ABRASIVE WHEEL
VERTICAL NIP
IDLER WHEEL
TEST PIECE
SPARE TEST PIECES
4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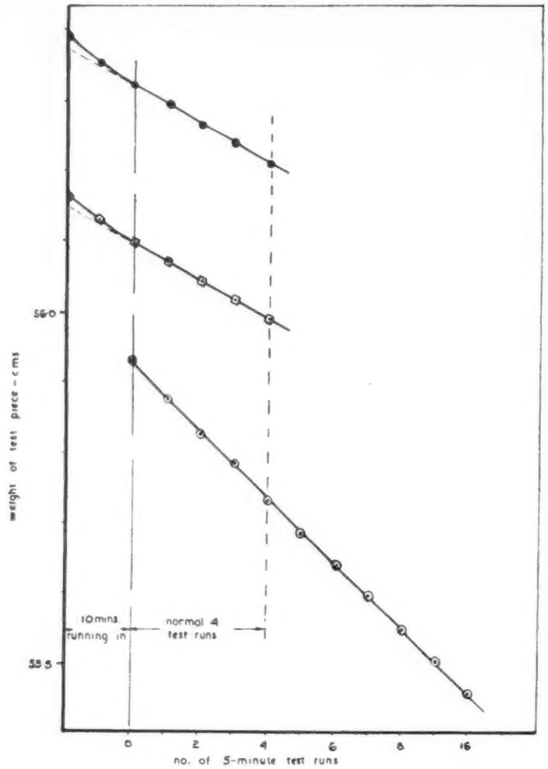

Fig. 6. Typical test piece weight losses during successive runs

From (3) and (4) $P_R = P_T\, v/V = (\%\ \text{slip}/100)P_T$ in Lambourn slip notation. (In practice, measurement of power differences include rubber losses and some bearing losses as well as P_R.)

Therefore tests at constant transmitted power through a constant slip drive give fairly complete control of all the energy factors of the system.

5. Constant Energy Methods

The rate of energy dissipation in the test piece can be controlled by alteration of either force or slip at the rubbing surfaces. In most machines the slip is maintained constant, giving a constant speed for the power control device.

Typical methods for five types of machine are now discussed.

5.1. Rotating Test Piece Driving a Rotating Abrasive Wheel (e.g., Lambourn Machine)

It is necessary to fix the speed of the output shaft; then apply a constant brake torque on this shaft to obtain constant transmitted power. Windage and friction losses are constant by virtue of the constant speed.

5.2 Fixed Test Piece Pressed against Constant-Speed Rotating Abrasive Wheel (e.g., Du Pont and National Bureau of Standards Machines)

Here all that is needed is a control for constant tangential force on the test piece carriers.

5.3. Test Piece Moving in Contact with a Fixed Abrasive Surface (e.g., B.S.A.T.R.A. Machine)

In this type the test piece can be made to move at constant surface speed, and the forces on the abrasive surface member measured and kept constant.

In each of these cases the most convenient method of control to hold both power and slip constant is by relatively very small adjustments of test piece contact pressure during running. Cases 5.2 and 5.3 are usually operated at much lower transmitted power than case 5.1, though it is possible to obtain a level for power absorbed in the rubbing pair equal to that of case 5.1 in some instances.

5.4. Constant-Speed Rotating Test Piece Driving an Abrasive Wheel with Axis Skewed to Produce Slip (e.g., Akron Angle Abrader)

Here some measure of the input torque on the test piece is needed, and the test must be run to maintain this constant. Manipulation can be either by small variations of test piece pressure, or by varying the slip angle. If, as may well be the case in small relatively inflexible solid rubber wheels, the abrasion loss is very sensitive to slip angle, then the load adjustment method is to be preferred. The slip-adjustment method could possibly be applied in the case of very flexible test pieces, e.g., tire structures.

5.5. Both Test Piece and Abrasive Surfaces Driven Independently (e.g., Tabor Abrader)

This is a complex device to operate under constant power and constant slip, but because of the interaction of the two drives, it is even more imperative to know the exact power transfer picture. It would be necessary to measure torques or tangential forces on each of the drives to the two surfaces. The two surface velocities would need to be controlled to be constant.

6. Dunlop Constant Power Lambourn Machine

A description follows of one interpretation of the constant-power principle applied to a Lambourn-type machine.

Figure 1 is a schematic block diagram, and Figures 2 to 5 show general views of two forms of this type of instrument.

6.1. Mechanically, the machine retains the principle of a rolling test piece driving a braked abrasive wheel except that the test piece runs on the edge of the wheel, not the face, as described in B.S. 903, a feature adopted in the later forms of Lambourn constant-slip machines. Provision is made for mechanical measurements of input power for calibration of the brake.

Also provision is added for adjusting and steadying the test piece pressure on the abrasive. Slip level is adjusted by this method throughout the test.

6.2. Electrical features are:

6.2.1. Very accurate speed control of the abrasive shaft by phase control derived from 50 cycles A.C. mains fed to a second eddy current brake fitted to the motor spindle. The circuit is based on a design by D. Bulgin to be published elsewhere. A series motor is

essential for this type of control. Variations of speed are no greater than those of the A.C. mains frequency.

6.2.2. Stabilized current supply to the abrasive shaft brake to govern transmitted torque.

6.2.3. Continuous display of slip ratio by a stroboscopic system operated from a light idler pulley running on the test piece surface.

6.2.4. Automatic cycle controlling and timing to simplify routine operation.

Trouble has been experienced in abrasion testing of some rubbers with stickiness on the test piece surface. This gives fictitiously low loss figures by causing particles to remain on the test piece, in extreme cases appearing as rolls on the surface and clogging up the abrasive surface. The effect is considerably reduced by controlled carborundum grit feed to the rubber-abrasive nip. Because of this, the later designs of machine (Figures 3 and 4) are arranged with the nip vertical. Special tests on other feed materials and devices are in Appendix A.

The abrasive is provided by "36-grit" carborundum wheels with fresh-fired surface (not redressed or trued after firing). These give a useful life of up to six months by using half of the full edge width to give two tracks by wheel reversal.

The main dimensions of the test piece and the abrasive wheel are the same as in the original Lambourn machine: namely, test piece: 1¾-inch diameter by one centimeter wide with a splined steel center; abrasive wheel: seven-inch diameter by one inch wide by ¾-inch hole.

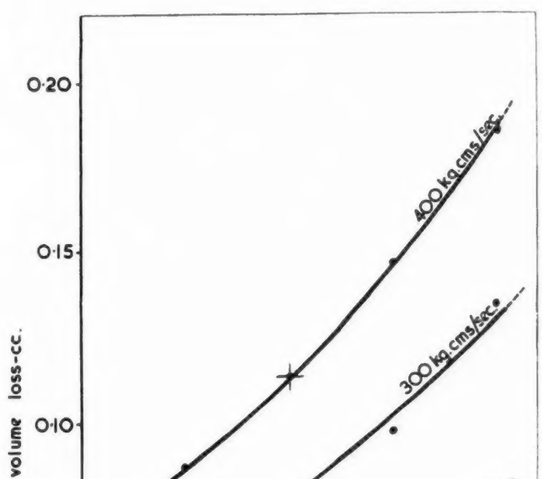

Fig. 7. Typical volume loss versus % slip

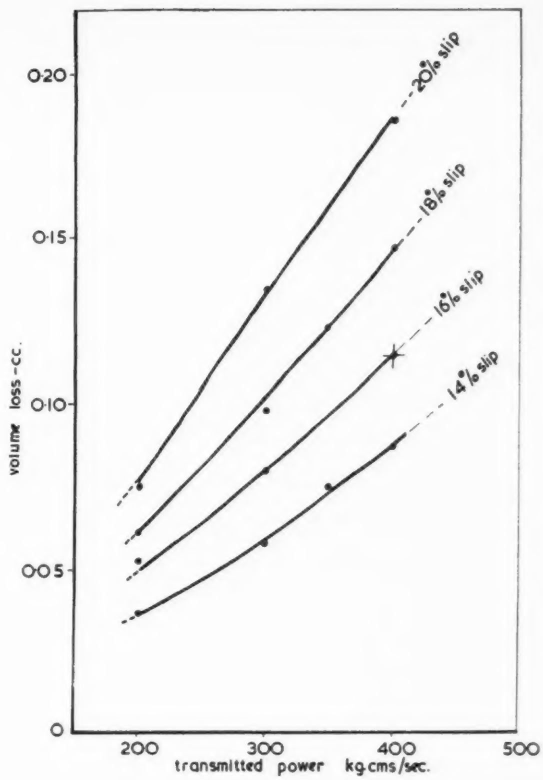

Fig. 8. Typical volume loss versus transmitted power

7. Test Methods

Each test piece is given a rough grinding on a separate device to insure concentricity, followed by a period of running in on the abrasion machine itself to aline the test piece surface truly with that of the abrasive wheel.

A complete comparison of compounds involves four runs of five minutes for each test piece, arranged on a randomized statistical plan for the testing so as to minimize the effect of abrasive and rubber variations.

The mechanical and electrical constants of the machine, e.g., output speed, brake current, slip ratio, are set at levels designed to make all tests at 400 kgm.-cm./sec. transmitted power with a slip ratio of 16%. These values were chosen so that the machine will run in a stable manner with some reserve for control and still place the greatest number of compounds in the order of merit found to exist in service. The test conditions can be varied, however, over a wide range whenever such variation is desired.

7.1 Reference Compound

Every comparison group is arranged to include a test piece from a batch of a standard reference compound, and all volume losses are referred as resistances to wear relative to the reference compound test piece on a percentage basis. A fairly large batch of the reference compound is mixed at a time, and the test pieces are cured in groups of 12 to 24 from this batch. Before being put into use, each fresh batch of reference test pieces must pass an acceptance trial. Rejection limits are based on

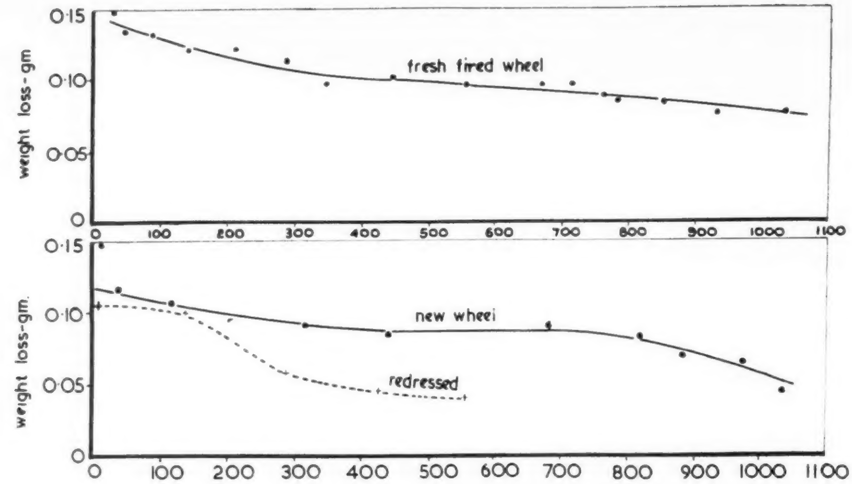

Fig. 9. Typical weight loss—number of runs during life of abrasive wheels

accumulated evidence of test error, in the form of a control chart.

7.2. Special Tests

In order to assess possible effects of other test variables, a number of special investigations were made, and these are outlined in Appendix B.

8. General Performance of the Machine

A number of these machines have been built in different Dunlop laboratories; the first two still are in use after 20 and 16 years, respectively. Five more of the No. 2 type—with the abrading nip arranged vertically—have been brought into use during the last eight to 10 years. The last two of these are somewhat improved in details, particularly the electrical and electronic controls, but are still based on constant transmitted power at constant slip ratio.

The rate of wear of a test piece with time during a test run, under the standardized conditions, is linear except for the running-in period. The preliminary running-in insures that the true test run does not commence until the linear condition is reached. Figure 6 illustrates this graphically.

The need of controlled standardized conditions is emphasized in Figures 7 and 8, which give typical curves of volume loss with % slip and transmitted power.

8.1. Wheel Life

During a series of tests the sharpness or effective abrading power of an abrasive wheel falls away gradually. This point is shown in the typical life curve of one compound on two abrasive wheels given in Figure 9. The testing technique in section 7 is designed to minimize this effect. As shown by the broken line curve of Figure 9, redressed wheels have an impracticably short useful life. By arrangement with the manufacturers, specially true-running fresh fired wheels are used. The wheels are rejected after once becoming blunt. They are not redressed and used again. When new wheels are brought into service, it is advisable to check their performance by first testing three or four different compounds of known abrasion indices.

8.2. Reproducibility

Error variability is continually examined by control chart methods. It varies with weight loss and abrasion index as shown in the representative table below:

LEAST DIFFERENCE REQUIRED FOR SIGNIFICANCE BETWEEN TWO COMPOUNDS AT A PROBABILITY LEVEL OF ONE IN 20

Abrasion Resistance of Highest of Pair of Results	Mean Weight Loss of Reference Compound		
Ref. Compound = 100	100 Mgm.	80 Mgm.	60 Mgm.
80	5	6	8
100	8	9	12
120	11	13	17

It is customary to reject abrasive wheels when the weight loss of the reference compound falls below 50 mgm.

8.3. Correlation

It is a long and difficult task to obtain enough data for an adequate correlation between road wear and laboratory abrasion loss. It is very rarely that enough vehicles and tires can be used exclusively for this purpose. Results often have to be collected from many small independent experiments and dealt with as statistically as possible to determine the most probable road correlation for the laboratory test.

Figure 10 shows the correlation obtained from one fairly large experiment run under controlled conditions, using test pieces from the actual treads which were run on the road. It will be noted that there is substantially a 1 : 1 relation. It is found that differences usually exist between laboratory mixed and production mixed rubbers, and between molded test pieces and strips from tires. Allowances for these have to be made when predicting road performance from laboratory mixed and cured test pieces. The general effect is to increase the

slope of the equivalent line of Figure 10 in the direction of greater sensitivity for laboratory molded test pieces.

9. Application of Constant Power to Other Machines

In sections 3 and 5 it was pointed out that any abrasion machine can be improved by adding power controls, and some tentative methods were given. Following this idea, two other machines have been converted to operate on these principles in the authors' company.

9.1. Constant-Power Du Pont-Type Machine

The modification was devised by W. A. Clarke, of Dunlop, to convert any standard Du Pont abrasion machine to operate on the new principle. Full details have been disclosed at the Conferences of ISO/TC/45 Committee and referred to as the constant torque Du Pont machine. In the main it consists of adjusting the test piece pressure on the abrasive wheel by a pull wire and spring system extending through the hollow spindle of the machine. The adjustment is made to maintain the torque on the test piece carrier arm constant judged by free floating between stops against the reaction weights on the extremities of the arm.

The improvement in results on the Dunlop Du Pont machine is shown in the following table.

Compound	Constant Torque	Constant Load	Road
A	100	100	100
B	92	145	92
C	85	159	80
D	73	100	75
E	63	54	75
F	38	50	59

9.2. Constant-Power U. S. Bureau of Standards-Type Machine

This machine is not yet completely evaluated. It consists of five test piece carriers, each on arms arranged to act as bending cantilevers against the torque action of the rubber held against the moving abrasive wheel surface. The forces on the cantilevers are measured electrically.

The machine is very simple to operate, capable of testing very small rubber test pieces, but its performance and best applications remain to be assessed.

10. The Mechanism of Abrasion Damage to Rubber

In seeking ways of improving abrasion resistance by compound or choice of polymer, it would be of great value to understand more fully the exact mechanism of surface removal and what forces and energies are involved. Buist and Davis (5) have attempted to establish correlation between other physical properties, more readily measurable, which has, however, limited validity. A more fundamental approach has been reported by A. Schallamach (6).

It is interesting to examine work published on metal grinding where a study was made of energy dissipation and temperature effects. A summary of this work relevant to the rubber abrasion problem follows.

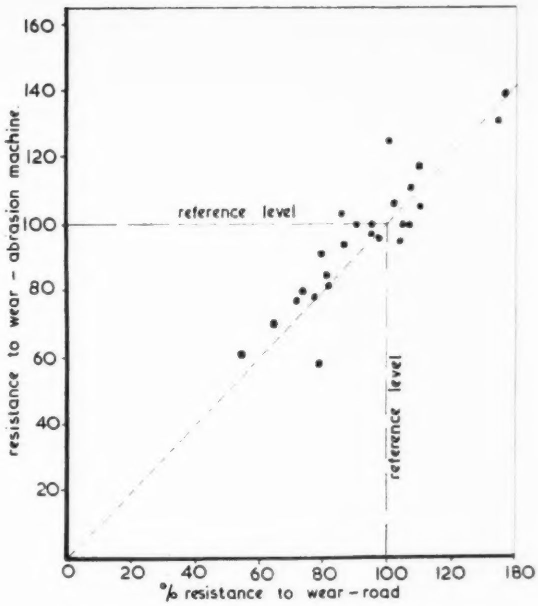

Fig. 10. Road correlation strip test pieces from road-test tire covers

10.1. The Grinding of Metals

Work published by Shaw and others (7) has established the general rule that the energy required to remove unit volume of a crystalline material like a metal by grinding or abrasion (defined as the specific energy) increases as the size of the removed particle decreases. As the size becomes very small (20 micro inches), the specific energy approaches an upper limit corresponding to the energy required to shear lines of atoms in the metal. This critical size proves to be that of the local irregularities in the crystal structure. Extending these principles to more general abrasive systems, the specific energy would be expected never to be greater than a value corresponding to rupture of the atomic and molecular structure of the material.

The importance of this approach in laboratory abrasion testing of rubber is in connection with attempts to speed up the rate of testing by using coarser abrasives and higher input power than the product meets in service. Larger particles are torn out, and the specific energy per unit volume removed is likely to be much lower than in service.

10.2. Disruption Energy of a Rubber Structure

It is difficult to calculate the maximum value of the specific energy of a rubber structure. The ultimate theoretical mode of failure might be taken as disruption of all bonds and reduction to isoprene monomer, in the case of natural rubber and to free particles of filler. This then involves an energy consumption equal to one C-C bond per isoprene unit, plus the heat of wetting of all compounding ingredients used. Further energy would have to be allowed for secondary bonds or van der Waals type forces between chains. This can be estimated from activation energy of plastic flow, or from the free surface energy of unsaturated hydrocarbons.

Some calculations on these lines are given in Appendix C, and the conclusion drawn is that the maximum energy needed to create new surface by abrading rubber is theoretically of the order of 2,000 ergs/sq.cm.

Using experimental figures for the size of the particles from two typical laboratory machines, an estimate is made in Appendix D of the theoretical maximum energy required to tear out particles from the rubber.

The figure thus derived is about

2.1×10^{6} ergs/c.c. volume loss

or 0.5×10^{-4} kgm.-cal./c.c. volume loss.

Comparable experimental energies required in various abrasion systems are given below:

Type of Abrasion	Typical Energy Dissipated per Unit Volume Loss Kgm.-Cal./C.C.
Constant energy Du Pont machine	5.4
Lambourn machine	4.1
B.S.A.T.R.A. machine (8)	0.25
Rubber brake blocks on smooth cycle rims	1000
Rusty cycle rims	100
Automobile brake shoes on smooth drums (9)	850
Cornering of tires on cars	1 to 25

10.3. Conclusions from Energy Calculations

The most striking conclusion from these figures is the completely insignificant part which the structure bond energy plays in the practical energy levels required for abrading rubber. Even the most vigorous abrasion machine (B.S.A.T.R.A.) gives a figure of 5,000 times the bond energy.

By comparison, the behavior of a crystalline metal shows a much closer correspondence with the theoretical energy under fine grinding conditions. The general effect of a large rise in specific energy of abrasion with increasing smoothness of rubbing agent is found in both cases.

In frictional rubbing, therefore, it seems that the great bulk of the work done is by repeated deformation of thin surface layers and consequent energy conversion by the asperities of the rubbing agent, without breakage of the structure. Only in extreme cases of interference of the surfaces are particles broken off and removed from the scene of action. Expressed briefly, it is therefore possible to visualize friction without wear, particularly on very smooth surfaces.

A further practical conclusion is that the ability of a rubber to deform and absorb large quantities of work at high temperature without fracture is the property which governs abrasion-resistance. This suggests that possibly tensile product (breaking load $\times$ breaking elongation) measured at 150° C. or higher, combined with fatigue resistance to rapid stressing, might be found to correlate with wear resistance.

11. Oxidation Effects at High Temperature

The temperature and oxidation phenomena in metal grinding are very important in the energy exchange.

Local temperatures were shown in reference (7) to be in the region of the melting point of steel, though difficult to measure. The glowing sparks from some metals were shown to be due to oxidation heating after leaving the nip.

Experiments on grinding steel in inert gas showed greatly increased forces and a large rise of specific energy, due to rewelding of chips to the parent metal and the necessity of repeated cutting of the same piece of metal.

In the case of rubber, although the disruption energies involved are lower than those of metals, it is very probable that the abrasive action involves temperatures at which physical properties are very much degraded, compared with their normal values. Furthermore, oxidation at these temperatures would lead to a sticky product, and the "chips" or ground powder would be more likely to adhere to the parent sample and cause a reduction of abrasion loss.

We have, therefore, almost the opposite case from that of metals, and it might be thought that a laboratory test in a nitrogen atmosphere would offset the stickiness problem due to excessive temperature and make the abrasion mechanism a closer approach to service conditions.

Experiments on these lines are reported in Appendix A. The use of nitrogen failed to eliminate stickiness, but this condition may be due to the great difficulty of removing the last traces of oxygen. The important suggestion remains that the chemical nature of the rubber in relation to oxygen is a vital factor in the mechanism of abrasion.

Possibly experiments in oxygen-enriched atmospheres may yield valuable information on polymers which are less readily oxidized than natural rubber.

12. Summary and Conclusions

This paper has been mainly concerned with presenting the case for power control in abrasion testing, and the implications of the better understanding of the mechanism of abrading. It is not claimed that the test machines described are perfect in their ability to assess resistance to wear action. There is still much to be done to remove anomalies that can still occur in results.

Acknowledgments

The work reported in this paper has been active over a long period and embodies results provided by many of the authors' colleagues. In addition to those referred to in the paper, we must acknowledge special gratitude to D. Parkinson for his continued support and interest, to B. J. A. Martin, C. H. Leigh-Digmore, and B. Pickup for more recent data and valuable criticism, and to C. E. Kendall for advice on more fundamental chemical matters.

Thanks are also due to the technical director of Dunlop Rubber Co., for permission to publish the work.

Appendix A

COMBATING TEST PIECE STICKINESS

Stickiness referred to in Section 6 has been experienced by all workers on abrasion. While in the early days only a few compounds seemed to exhibit this effect, most

modern compounds are affected to some degree. When stickiness exists, abraded particles do not leave the test piece, but remain adhering to the sticky surface to be rolled repeatedly under the abrading contact. The final measured weight losses are then fictitiously low for the purpose of abrasion assessment.

Many devices were explored to combat this phenomenon; none was completely successful for all compounds. These are listed below:

1. Water spray into the nip.	Weight losses extremely low, 2-3 mgm. in one hour.
2. French chalk into the nip.	Weight losses extremely low, 1-2 mgm. in two hours.
3. Scrapers on the test piece.	Aggravated the stickiness. Rolls not removed.
4. Fixed wire brushes on the test piece. 5. Fixed bristle brushes on the test piece.	Tended to increase stickiness without removing rolls.
6. Rotating bristle brushes on test piece.	Removes drier detached particles—no effect on rolls or stickiness. Adopted as on original machine.
7. Finer grit abrasion wheel.	Aggravated the stickiness.
8. Emery flour into the nip.	Weight losses extremely low.
9. Emery grits into the nip. 36, 60, 120 mesh (and mixtures).	Weight losses rather variable.
10. Enclosing test apparatus in an inert atmospere—nitrogen.	Even though careful flushing out remaining air, after evacuating many times, with N_2, and similar treatment of the rubber test pieces, stickiness still occurred to the same degree as normal testing. (Possibly still traces of air present in spite of treatment.)
11. Carborundum grits into the nip. 12. 36 grit carborundum.	Grit size too large for easy governing constant flow.
13. 120 grit carborundum. 120 grit Crystolon.	Weight losses uniform. Flow controllable constant. Satisfactorily removed stickiness for many compounds.
14. 80% 120 grit Crystolon[4] and 20% Emery Flour.	Weight losses still uniform. Removed stickiness to a greater degree and handled more compounds than 13.

Method 14 was adopted, but there are still some rubbers which are too sticky for reliable abrasion results. The practical answer is that any grit which can be guaranteed for size and hardness of this order of mesh should be satisfactory if fed at constant rate close into the nip.

Attempts to correlate compound constituents with stickiness have not proved very convincing.

Appendix B

SPECIAL TESTS

B.1. Ambient Temperature and Abrasion

Using the same enclosure system devised for the nitrogen tests, Appendix A, tests were made under ambient temperature conditions over the range 20 to 100° C.

The weight loss on the natural rubber tread compound tested increased linearly with temperature. This is shown in Figure 11, together with the reciprocal curve of resistance to wear *versus* temperature.

On this evidence, since the main testing laboratories change temperature over a wide range during a few months, it was decided that the abrasion machine should be operated in the special controlled temperature laboratories (20 ± 2° C.).

[4] Norton Co., Worcester, Mass.

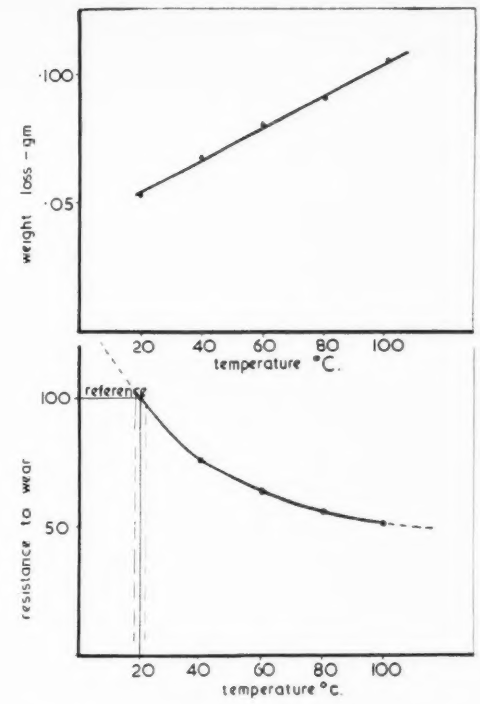

Fig. 11. Effect of ambient temperature on abrasion of natural rubber tread

B.2. Half and Half Centers

A half lap split steel center was devised to enable half test pieces to be built from two rubbers of a comparison. This was thought to be a possible equivalent of the road test and half treads which are frequently used in investigations as a method to reduce some road test variables.

This design of test piece was not successful due to the slip ratio for a given beam load setting being different for each half wheel. The slip stroboscope image remained steady due to the rotary inertia of the test piece drive, and the test run was made at a mean slip of 16%. The energies and slip on each half, however, are not equal; hence the two halves are not tested at strictly standard conditions. The practical effect was to reduce the differences between compounds to an unacceptable level.

Half and half test covers may suffer from a similar interaction rendering road evidence from these tests less valid than is usually assumed.

B.3. Pneumatic Test Piece

Following a suggestion that a more flexible test piece construction may make for less variability, a simple hollow inflatable rubber test piece wheel was designed, small enough to fit the existing machine (i.e., 2½-inch diameter) with a one-centimeter wide tread molded integral with it.

A number of experiments were made, but it was found that variability increased rather than decreased, and crowning of the tread, due to the increased flexing under load, produced an ever-changing stiffness. Further, it is quite difficult to maintain constant inflation pressure in so small a volume, due to leakage difficulties, and this constitutes another control to be handled. Best results, and even these were poor, were obtained with atmospheric inflation pressure. Mechanically the machine ran very smoothly and silently with this type of test piece.

It was concluded that the effects of test piece flexibilities and stress encountered in this type of wheel are better left to tests on full-scale tires using larger apparatus, or to detail analysis of road tests. A laboratory test of the type dealt with in this paper is primarily concerned with determining the resistance to wear of a compound, not test piece shape factor and design effects. To deal with these product design effects it may be necessary to apply corrections, based upon results from separate study of the factors when predicting performance of a compound in two different tire or product constructions. This does not affect the separate conception of resistance to wear index or the compounded rubber.

B.4. Abrasive Materials

Originally, abrasive papers of the water glue bonded type were tried in strip form on a seven-inch diameter by one inch wide drum. These were very variable ($\pm$ 10% on weight loss), owing, no doubt, to the weakness of the glue bond. It is proposed to reopen this work using the newer Tri-M-ite[5] (I.S.O. batch) papers used on Du Pont machines in due course. This may lead to a more economical system for standard abrasive surface.

Early in the work of applying constant energy principles the possibility of more permanent abrasive surfaces, e.g., diamond grit, boron carbide grit, was discussed with the manufacturers. No standard production of suitable grit size wheels (approximately 36 grit) exists, and special production would be prohibitive in price. The price, however, could be secondary in importance if these types of wheel proved to be more permanent. Experiments with existing fine diamond dust wheels proved useless; these simply aggravated stickiness. Development of this approach was not carried further.

Appendix C

ENERGY REQUIREMENTS FOR BOND BREAKAGE

Considering the ultimate unit likely to be involved in the finest possible abrasion action as the isoprene unit in the rubber chain, the bonds holding these in place are regarded as consisting of one covalent C—C bond per isoprene unit, the associated secondary van der Walls type forces between adjacent side groupings, and an occasional vulcanization cross-link.

The orientation of the isoprene units with reference to any particular plane of possible rupture is random in unstressed rubber, but the act of stressing increases the degree of orientation normal to the plane of rupture.

C.1. Assuming firstly that all the bonds are fully orientated, the maximum number of covalent bonds will need to be broken, i.e., one per isoprene unit present at the new surface created.

Taking the C—C bond strength as 80 kcal./mole, and (10) the size of the isoprene unit cell normal to the main chain as $27A^2$, we get:

$$\text{Energy per molecule} = \frac{80 \times 4.185 \times 10^{10}}{6 \times 10^{23}} = 5.6 \times 10^{-12} \text{ ergs.}$$

$$\text{and energy per sq.cm.} = \frac{5.6 \times 10^{-12}}{27 \times 10^{-16}} = \text{approx. } 2000 \text{ ergs.}$$

C.2. Now in the case where rupture occurs so that no covalent bonds are involved, but only the secondary bonds, the figure may be taken as approximately twice the free surface energy (i.e., twice the surface tension figure for simple unsaturated hydrocarbons). This gives about 60 ergs/sq. cm., a much lower figure than C.1.

The stress at the region of rupture will increase the orientation in the direction of stress, so that a high proportion, say 50% of the strong bonds will be involved.

The effect of carbon black reinforcement is a further increase in the work to be done on bond breakage. Judged by increase in tensile strength, the increase is 1.5:1 for natural rubber, and as high as 4:1 for butadiene-styrene rubbers, compared with the gum stock. Judged by increase in resistance to wear, the effect of blacks is as much as 4 or 5:1 for a fully reinforcing black under some types of wear conditions (11). For the purpose of this estimate, we will take the carbon black factor as 2.0.

The effect of the occasional cross-links between chains due to vulcanization can be ignored, because it is probable that the ultimate plane of failure will divert to follow the weaker portions of the molecular network which exists between cross-links.

We may speculate, therefore (and the simplified assumptions do not warrant any stronger word), that the maximum theoretical energy attributable to bond destruction in creating each sq.cm. of new surface is of the order of

$$2000 \times 0.5 \times 2.0 = 2000 \text{ ergs/sq. cm.}$$

for a carbon black reinforced rubber.

The use of plasticizers which may be regarded as increasing the lateral spacing of chain segments will have the effect of reducing this figure, as van der Waals forces will be reduced, and the number of strong bonds in the plane of rupture will be decreased.

Appendix D

INCREASE OF FREE SURFACE AREA INVOLVED IN ABRASION

In order to use the energy figure calculated in Appendix C, it is necessary to estimate the amount of new surface created in grinding off a unit volume of material, and this is obviously dependent on the particle size.

Consider the particle to be approximately cubical of side x. In its orginal position five of the square faces are bonded, and one free. These five faces must be broken to free the first particle, but subsequent adjacent particles need only four faces to be broken. The total area increase for a large number of small particles is therefore only $4x^2$ to a close approximation.

In unit volume, number of particles $N = \frac{1}{x^3}$ and increase of free surface is $\frac{4}{x}$ sq.cm./c.c.

Measurement of particle size distribution from laboratory abrasion machines gives the following data.

	Du Pont (Constant Energy)	Lambourn type (Constant Energy)
Mean particle size number ($m\mu$)	40	37
Range of size ($m\mu$)	10-250	5-300

(The harmonic or reciprocal mean was taken in order to use the figure in calculating the surface.)

Taking 38 $m\mu$ as an average for the two machines, the new surface for unit volume loss is:

$$\frac{4}{38 \times 10^{-4}} = 1050 \text{ sq.cm./c.c.}$$

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EDITORIALS

Interrelation of Science and Technology in the Rubber Industry

PROGRESS in a manufacturing industry such as rubber might be said to be based first on science and then on technology. Efficient management and adequate funds are, of course, among the other basic essentials for such progress, but these are also necessary for all other forms of business enterprise. Many of these latter are dependent only to a limited degree, if at all, on science and technology.

There is some reason to believe that the scientific and technically trained men in the rubber industry, as well as management itself, sometimes lose sight of just what is meant by science and what is meant by technology. The terms are not necessarily synonymous, but are interrelated, as should be those persons devoting the majority of their time in either of these two fields—and herein lies the story!

Science may be defined for our purposes as "systematized and verifiable knowledge reached by observation, measurement and/or experiment"; while technology can be described as "a branch of science that deals with methods of manufacturing materials from vegetable, animal, or mineral sources."

Among the scientific and technical organizations in this country having divisions or committees interested either wholly or in part in rubber and elastomers, are the American Chemical Society, American Society for Testing Materials, American Society of Mechanical Engineers, American Physical Society, and the American Institute of Electrical Engineers.

Some of these rubber and elastomer organizations are interested primarily in the scientific aspects, and some only in the technological aspects of these materials.

In the recent past we have called attention to the growing interest, mostly at the local or regional level, in courses in rubber technology by the technical men in the industry. It appears from an examination of the make-up of some of these courses, however, that they are required to include information in the fields of pure and applied science as well as technology in order to satisfy the participants.

In an accompanying guest editorial in this issue by Louis H. Howland, Naugatuck Chemical Division, United States Rubber Co., it is pointed out that because of the requirements of the rubber and related industries for new polymers, these industries should do everything possible to encourage expansion of facilities for training polymer scientists.

Returning now to the rubber and elastomer divisions of the several national societies, an examination of their meeting programs reveals a greater or lesser degree of overlapping of science and technology in these programs. It could also be said that there are many fields of more or less common interest. Possibly this situation is not always realized by the officers and members of these organizations.

It is suggested that in the interest of maximum industry progress, joint meetings of two or more of the rubber and elastomer divisions of the different national societies might be of distinct mutual advantage. Some of these organizations have been considering such joint meetings in a preliminary way. Particular attention should be given to arranging the programs of such meetings in a manner that would give the scientists a better understanding of the problems of the technologist, and *vice versa.*

According to one of our major manufacturing corporations, "Progress is our most important product," and any means of furthering progress in the rubber industry should be welcome.

R. G. Seaman

EDITOR

Guest Editorial

Elastomer Development and the Need of Trained Polymer Scientists

LOUIS H. HOWLAND

Naugatuck Chemical Division, United States Rubber Co.

TWO or three decades ago compounders were having only moderate success trying to make oil-resistant vulcanizates from natural rubber by the use of certain compounding ingredients and tight cures. It was not until the matrix was changed, and nitrile, chloroprene, or polysulfide rubbers were used instead of natural rubber that vulcanizates with satisfactory oil resistance were obtained.

Similarly, when rubber products with improved low-temperature properties were desired, some progress was made with certain plasticizers in natural rubber and by emphasis on proper vulcanization conditions, but as the service temperatures were lowered, it was only by the use of specially designed synthetic rubbers such as high butadiene GR-S, silicones, and fluorocarbon rubber that products with acceptable low-temperature properties could be made.

Improvement in the resistance to air loss in automobile inner tubes was not achieved by compounding natural rubber, but by the development of a copolymer of isobutylene and a conjugated diene hydrocarbon, which was found also to have superior resistance to oxygen and ozone at both ambient and elevated temperatures.

The new elastomers, without which the accomplishments just mentioned would not have been possible, resulted from the work of polymerization scientists. Of course, the success of the final end-product was aided by compounding research in many cases, but the solution of such problems depends primarily on a thorough understanding of polymer chemistry.

Better and better elastomers will be required to solve the problems of the future. Highly trained chemists, physicists, and engineers will be needed to design and use the new polymers required. One would expect that these technical people should be very enthusiastic about polymer chemistry.

In interviewing chemists for positions, however, many highly trained men say they are not interested in polymer chemistry because they say they know very little about it; they feel it is too difficult; and they prefer to work on chemicals with more readily understandable structures.

The interest in and enthusiasm for polymer chemistry should result from specialized courses in our colleges and universities. Such courses are available in some locations including those in colleges and universities that have research contracts for work on synthetic rubber, but it is felt that more training sources should be available in view of the increasing importance of polymer research. Because of the present and future requirements of the rubber and related industries for new polymers, these industries might do well to take a good look at training facilities for future polymer scientists, and if they feel the situation warrants it, do everything possible to encourage expansion of these facilities.

Meetings and Reports

AIEE Rubber & Plastics Subcommittee Automation Conference

The Rubber & Plastics Industries Subcommittee of the General Industry Applications Committee of the American Institute of Electrical Engineers held a most successful two-day conference on "Automation in the Rubber and Plastics Industries," at the Mayflower Hotel, Akron, O., April 4 and 5. The General Industry Applications Committee and Subcommittees deal with all matters in which the dominant factors are the requirements, selection, installation, and operation of machinery and devices used in the machine tool field and in the fabrication of nonmetallic materials such as textiles, rubber, paper, and plastics.

This conference is the seventh to be held by the Rubber & Plastics Subcommittee, and its chairman, W. S. Watkins, Ohio Rubber Co., presided at the technical sessions and at the banquet held in the Mayflower ballroom on the evening of April 4, at which J. E. Trainer, executive vice president, Firestone Tire & Rubber Co., was the speaker. R. D. Heyburn, Firestone, was chairman of the local committee on arrangements. About 350 members and guests of the AIEE Subcommittee on Rubber & Plastics attended the conference.

Trainer on Industry's Story

The subject of Mr. Trainer's talk was "Industry Must Tell Its Story." It was emphasized that management does not go far enough in explaining to its employes and the public the economic record of industry in this country in providing more jobs, higher incomes, and a constantly rising standard of living. According to the February, 1955, public opinion index for industry survey of the Opinon Research Corp. on the subject of "Progress Sharing," 47% of the workers indicated that union leaders were doing the most to improve living standards in this country, 18% attributed the major effort to business leaders, and the same percentage to government leaders.

Mr. Trainer pointed out also that 20 million more people will be in our work force by 1975, and that industry must build enough plants and factories to employ these people. In so doing, industry is meeting its obligations not only for this generation, but for our sons and daughters, and this fact should be brought home to industry employes and the general public.

In touching on automation, the theme of the AIEE Subcommittee conference, Mr. Trainer said that contrary to much that has been printed and said about the possible results of automation, he believed that instead of decreasing employment, employment will be increased. The sooner the public is enlightened on this matter, the better, he added.

The speaker urged his audience to take an active part in the cooperative activities of the community and be extremely selective in its choice of candidates for public office. If we do not carry out our responsibilities, the forces opposing free enterprise will win the fight through our default. If, on the other hand, we clearly realize the present danger and take the steps necessary to combat it, we will triumph, Mr. Trainer said. For the nation's good and the welfare of the American people, our responsibility is quite clear, he concluded.

Conference Keynote Address

"The Engineer and Automation in the Process Industries," by Everett S. Lee, director of technical public relations, General Electric Co., and past president, AIEE, was the subject of the keynote address on the morning of April 4.

Mr. Lee said that automation, which is blamed as the reason for our ills and credited as the source of our joys, to the engineer is an evolution in manufacturing operations from manual operation to mechanization, and thence to automation.

Today's industrial interpretation of automation is—continuous automatic production. It is a concept of manufacturing based on continuous flow, rather than intermittent batches of work. It embraces the automatic making, inspecting, assembling, testing, and packaging of parts and products in one continuous flow.

The man on the production line, as we know him, has been trained and upgraded to become the skilled machine specialist or maintenance expert. Continuous automatic production starts in a small way when fully automatic machines are integrated with transfer devices to perform a series of operations. By logical steps these machines are grouped into automatic units; then the units are grouped into an automatic system, the system into an automatic section, and finally some day we may come to expect the automatic factory. In the rubber industry the combining of more and more operations into the continuous processing fabric calender train is an example of this evolution toward automation that has been going on for several years, it was said.

The era of the so-called automatic pushbutton factory is still ahead of us, however, except in some process industries, such as chemical, petroleum refining, and some foods. Automation, as such, will have to pay its way in a step-by-step program as industry takes a practical approach to the diligent use of each year's expanding technical advances in manufacture.

The speaker pointed out that the population of the United States increased 22% between 1939 and 1953, and in the same period the number of jobs went up 35%. In the field of manufacturing where automation has advanced most rapidly, Federal Census figures show that employment increased 73% during these same years. Yet the predicted available work force will increase less than 13% by 1964. The solution of the vital problem of obtaining increased industrial productivity—one of the great challenges and opportunities today—has come to be characterized by a word, perhaps the most misunderstood in our modern vocabulary, this word "automation," Mr. Lee said.

It is up to the electrical engineer, working with management, to learn about automation, study it, and apply it to the processes with which he is working for the advancement of electrical living and so that the people of this country may continue to have a continuing increase in their standard of living which has brought this nation into world leadership, Mr. Lee concluded.

Technical Papers

"The Status of Automation in the Rubber and Plastics Industries," by G. V. Kullgren, Hale & Kullgren, Inc., Akron, was the first technical paper on the program. The paper was delivered by W. H. Woodrow, of the same company, in Mr. Kullgren's absence.

This author pointed out that the installation of mechanization and automatic controls in the rubber industry has been accelerated in recent years under the pressure of keen competition and increasing labor costs. Under raw material receiving and storage, mention was made of bulk handling systems, for carbon black as well as for other compounding ingredients, where the volume would justify the expenditures necessary for such systems.

Compounding and mixing in which the raw materials are brought to the Banbury in a form suitable for automatic weighing provide almost completely automatic operation. Operations of this type will become more prevalent in the industry as it becomes evident that the mixing capacity for a plant can be almost doubled by converting to high-pressure Banbury mixers with automatic compounding without increasing the number of mixers in the plant, it was said.

Further improvement of the extrusion operation involving the use of more automatic controls was suggested as a means of increasing the degree of automation in connection with the forming of tire treads,

etc. Mentioned also were automatic tire building machines and the use of volumetric blankers for providing savings in materials and labor for mechanical molded goods.

A continuous process for extruding plastic sheet into a vacuum forming machine to produce plates, trays, cups, etc., which were then packaged automatically, was cited as an example of automation in the plastics industry.

One of the objections to automation is the increased maintenance cost, and every effort should be made to make sure that the equipment, control devices, and instruments selected for this work be of the most rugged type, it was said. In this way the complaint that automation merely substitutes maintenance mechanics for labor can be avoided.

The author concluded that the present-day climate in the rubber and plastics industries requires some degree of automation in order to exist both now and in the increasingly competitive markets of the future.

Paul C. Taylor, Mansfield Tire & Rubber Co., in a prepared discussion of the Kullgren paper emphasized that the compounding and mixing departments in rubber goods plants afford a great challenge to automation, and the benefits obtained can be very large. Tire cord dipping and calendering operations, along with the mechanical handling of extruded treads, etc., may achieve complete automation with addition of automatic stock gage or thickness control. In both preforming operations and curing, many advances have been made in recent years, but visual inspection of the processed part is still a valuable means of reducing scrap losses.

Mr. Taylor emphasized that the challenge to engineers today is to study the basic elements as applied to each phase of automation and then recommend the most economical application to the problem. Management is well aware of the value of automation, but its cost must be reasonable, or the project will not receive proper consideration.

Charles Mayer Studios

Rubber & Plastics Industries Subcommittee of the General Industry Applications Committee of the American Institute of Electrical Engineers, Akron, April, 4; W. S. Watkins, chairman, seated third from left

"Electric Drives for Rayon and Nylon Tire Fabric Machines," by C. E. Robinson, Reliance Electric & Engineering Co., was the second paper of the technical program. The first electrical drive system used for rayon tire fabric dipping installations was similar to the machine used in the cloth finishing division of the textile industry, but modified to permit the changing of fabric stock rolls at the entry or exit end without stopping the machine itself.

As higher tensions were imposed on the rayon cords as they were being dried in order to reduce growth in the finished tire, the dancer rolls in the system were weighted to provide this increased tension, but then larger drier motors were required. Redesign of the system involved a set of pull rolls with drive to pull the fabric through the drying system and removal of the drier motors. Also a structurally stronger dancer roll system, loaded by means of an air actuator instead of by weighing, was added.

Increased frictional resistance with this first modification of the early rayon fabric dipping installations was followed by a modification of the dancer roll system for measuring tension and a system based on controlling the booster generator shunt field excitation. This latter system measured tension by measuring pull roll motor current. The accuracy of this system, under steady state conditions, depends upon the uniformity of motor field flux as provided by an adequate current regulator, and the uniformity of friction and windage in the entire pull rolls system.

Drive systems for nylon tire cord fabric had to take into account the greater extensibility of nylon as compared with rayon. Much higher tensions under higher and more closely controlled temperatures to prestress the fabric prior to calendering are required. In those cases where tension is the variable to be controlled, either the dancer roll system or the current regulator system, mentioned above for rayon processing, may be used for nylon.

Since one school of process engineers feels that the variable to be controlled in processing nylon tire fabric is the degree of stretch, drive systems for that purpose were described also.

G. A. LeMaire, United States Rubber Co., in his comments on Mr. Robinson's paper, dealt with some of the plant engineer's problems in operating tire cord fabric dipping units. Among other things, Mr. LeMaire said he felt that tension control by armature current regulation offers several advantages over air loaded dancer rolls because there are no moving parts, and current response is quicker. Other difficulties mentioned included tension variation due to pressure rolls squeezing too much solution out of the fabric, and the long range of calender speeds and sudden stops developed when attempting to deliver the solutioned fabric directly to the calender from the dip machine.

Franklin E. Palmer, The General Tire & Rubber Co., suggested that with the higher and higher tensions now required the starting conditions for the main generator present a difficult problem in regulation, commutation, and protection of the generator. Mr. Palmer also favored the all-electric tension control system and proposed that a direct tension measuring device such as a strain gage might further improve this system. He favored the controlled stretch system for nylon since mechanical devices have been eliminated from this system.

"Comparison of Rubber Calender Thickness Gages" was the title of a paper by R. F. Snyder, Goodyear Tire & Rubber Co. This author compared the ramification of certain gages for use with rubber calenders in order of their chronological appearance.

The first of these gages was the caliper-type gage which required that a small sample be cut from the sheet and also required an incessant program of sampling, measuring, and adjusting operating conditions in order to produce material with any reasonable degree of precision.

The magnetic or Schuster gage was credited with the first step in making calender operation a science instead of an art. This gage was first available as a "deviation" type as distinguished from the present-day direct reading type. It was said to be simple to install, operate, and maintain, and to be rugged, low in cost, and long lived. It has some weaknesses, however, such as non-linearity, warm-up drift, and backlash on settings and is subject to unpredictable error due to accidental accumulation of small amounts of foreign material and dust collecting on the wheels and magnets, according to Mr. Snyder.

The capacitor-type gage requires that the measuring plates be as close together as possible without touching the sheet, which requirement necessitates at the same time that one or both of the capacity gage plates be instantly and easily movable to prevent damage when a fabric splice, lump of rubber, or other obstruction must pass through the air gap. This type of gage has been in operation since 1926 and gives

satisfactory performance where deviation-type indication is acceptable.

The X-ray gage was the first instrument to take advantage of the fact that the transmission of penetrating rays through an opaque material was accompanied by an absorption of rays somewhat proportional to the mass of the material. The effects of many factors in the nature of X-rays themselves and the equipment used to produce them, however, limited the value of this gage until such time as rays from radioactive isotopes could be used instead of X-ray generating tubes.

The beta ray gage is surely destined to play an ever-increasing role in the gaging of sheet materials. It is available as either a transmission or back scatter type. The back scatter or reflection type of gage has had only limited application in the rubber field, but there seems to be considerable evidence that some of the early obstacles to its use now appear inconsequential when it is used on lightly loaded rubber compound sheets of a few thousandths of an inch in thickness. For thin rubber stock, it may be even more accurate than a transmission absorption gage, it was said.

Mr. Snyder said in conclusion that the beta gage is doing a magnificent job and that the next ten years should see its application to many other measuring jobs in the rubber industry.

Gilbert Corwin, Tracerlab, Inc., in commenting on Mr. Snyder's paper stated that four back scatter gages and one transmission gage of the beta ray type have been installed on rubber calenders. Back scatter gages have also been used in connection with the manufacture of surgical and industrial tapes and cellophane and vinylite tapes.

Although some prejudice exists against the use of the back scatter type of gage with loaded rubber compounds, a large rubber company determined by experiment that wide variations in the zinc oxide content of a given stock did not affect the accuracy of this type of gage.

In tire fabric coating work the back scatter gage is the only type that can be used on the four-roll "Z"-type calender; while on a three-roll calender, the back scatter gage is more effective and less expensive than the transmission type.

"Automatic Weighing Systems—A Symposium," consisting of four papers, was presented under the chairmanship of A. G. Payne, of Monsanto Chemical Co. In his introduction, Mr. Payne pointed out that Banbury mixers are now being operated by a girl behind a desk in a control room, and that this achievement has been made possible by progress in the design of systems which automatically select and weigh specified ingredients and inject them, each at the proper time into the mixers.

"Application Problems of an Automatic Weighing System," by R. V. Fisch, of Ohio Rubber, was the first paper of this symposium. For most rubber applications, accuracy of $\frac{1}{10}$ of 1% of full range seems to be the accepted tolerance, but a weighing station intended to weigh amounts up to 40 pounds will have difficulty weighing and injection of one-half pound to an acceptable tolerance. The obvious solution here is the use of the masterbatch technique, it was said.

Factors other than the weighing mechanism are more influential in larger weight categories, and the engineer must make his selection of weighing equipment to suit requirements in addition to accuracy. The method and the rate at which materials are sent to the weighing mechanism will affect consistent accuracy. A careful study must be made of the feeding conditions, flushing, and column of material in air. Material handling characteristics of *each* material must be analyzed for storage, removal from storage, feeding to weigh bins, discharge from bins, and charging into the mixer, Mr. Fisch pointed out.

Each automatic batch weighing system will present many different engineering problems; nevertheless workable solutions can be found, it was added. Returns from engineering and investment made in a self-acting and self-regulating system are so inviting that tire producing companies cannot avoid the installation of this automation for rubber mixing operations. An analytical study will reveal amazing advantages in these systems for many mechanical goods plants, Mr. Fisch said in conclusion.

"Electrical Transducers for Automatic Weighing," by R. E. Bell, of Toledo Scale Co., was the next paper of the symposium. Electrical transducers of the following types would probably be considered for application to scales: (1) linear differential transformers; (2) synchros; (3) potentiometers; (4) strain gages. Also, for strictly set point applications magnetic mercury switches and photoelectric cutoffs would be considered.

In many ways the linear differential transformer is about the most universal transducer available for industrial applications, Mr. Bell said. It can be used for set point or proportional applications, although in scale applications some circuit adjustments or trimming of transformers is necessary to obtain a linearity of $\frac{1}{10}$ of 1%.

Synchros have certain advantages in some scale applications. Where only remote indication is required and where rotary motion is available, they excel. They are capable of high resolution and good stability with respect to line voltage and temperature and can be made to have sufficiently low mechanical loading on the scale. Synchros, however, have certain disadvantages, when control is needed, in that they can only be used effectively in pairs, and their electrical characteristics must be properly used.

Potentiometers are presently available which meet some of the requirements of an electrical transducer for scale applications. It does not seem possible, however, to combine characteristics in one potentiometer such that it will be generally suitable for direct application to mechanical scales, according to this speaker.

Strain-gage load cells have the advantage of simplicity of load supporting structures required, corrosion resistance, low maintenance, flexibility, fast response, and low installation costs. Their disadvantages include the high cost of the cell itself, limited accuracy, the fact that they are limited to high capacity work, that they are subject to overload damage, and are at a disadvantage where the ratio of the live load to be weighed is small compared to the dead load.

This speaker emphasized in conclusion that no one unit could be selected as best for all weighing purposes, but that by presenting the advantages and disadvantages of each type the design engineer should be helped in making a proper selection for his particular automatic weighing problem.

"An Approach to Automatic Weighing Systems," by J. C. Williams, Jr., Weighing Components, Inc., was the third paper of the symposium. This paper separated the weight control system into four logical divisions: (1) sensing; (2) indication; (3) controlling and interlocking; and (4) material handling, and showed some of the ways in which various units of these four divisions could be combined into a single integrated automatic weight control system.

It was explained how the sensing division can be made up of electrical, pressure, or mechanical units, or a combination of these units. The indication division can also be made of electrical, pressure, and mechanical units. Indication has no advantage for weight control systems, however, except for setting and/or resetting the weighing function and satisfying the operators, managers, and engineers' desire to see what is going on, it was explained.

The controlling and/or interlocking division can likewise be separated into electrical, pressure, and mechanical units, with an additional subdivision which includes those units which are both electrical and pressurized in nature. In this division some overlapping also takes place since certain mechanical forms are employed in the electric and pressure devices.

Material handling units, such as feeders, valves, conveyors, gates, etc., may also be divided into electrical, pressure, and mechanical units, but were not dealt with in detail in this paper.

Since it is generally conceded that load cell weighing has the greatest potential for complex automatic weighing systems, mechanical aspects were not concerned as being within the scope of this paper. The two remaining categories (electrical and pressure) for each of the three main divisions (sensing, indicating, controlling) may be combined in eight different ways to provide a complete system. A table of these combinations was shown, and three combinations were discussed in detail.

"Dial Scale Instrumentation in Automatic Batch Weighing," by Walter M. Young, Richardson Scale Co., was the final paper of this symposium. Instruments that permit complete remote control for the process engineer, step up the production rate for the production engineer, improve quality for the quality control engineer, and provide records and data for inventory, purchasing, billing, and costing departments have been successfully applied to the dial scale, it was said.

The several instruments used for dial scale instrumentation were reviewed. This

speaker then emphasized the importance of knowledge of the characteristics of the materials being handled with relation to the materials handling equipment selected. In summary, it was said that in order to assure an accurate weighing system there must be: (1) uniform and consistent material flow to the weigh bucket; (2) a precise load sensing device; (3) the necessary precision instruments and controllers to embrace the entire system.

To compromise with one of these three phases of a batching system will result, without question, in a weak system. All three phases must be compatible to round out the perfect system.

"Comparison of Rotating, Electronic, and Magnetic Amplifier Regulators," by J. P. Montgomery, Westinghouse Electric Corp., was the first paper on the program the morning of April 5.

Rotating, electronic, and magnetic amplifier regulators are tools with which the design engineer works to solve the problems created by the growth of automation, it was said. A regulator is an automatic device for maintaining or adjusting the current, speed, etc., of a machine, transformer, or the like, and in the rubber and plastics industries they are applied as voltage, current, speed, tension, and position regulators, to name but a few of the many applications.

The rotating regulator is fundamentally similar to a standard D.C. generator. It requires a drive motor which takes power from the A.C. line and converts it into rotating energy. It then reconverts this energy to a controllable D.C. output which can be used either to excite the field of another machine or directly in the armature circuit. A very important characteristic of rotating regulators is their ability to reverse polarity. Typical applications of rotating regulators are as booster-type regulators to maintain constant current in pull roll and tension roll motor armature circuits on rubber-calender tandem installations, as a speed regulator with tachometer feedback to maintain rubber-calender speed constant, and to maintain constant wind-up tension at the end of a calender coating process.

Electronic amplifier regulators are made possible today from conventional multi-element vacuum tubes working in conjunction with power tubes such as thyratrons and ignitrons. This combination makes possible gains not easily attained by either rotating or magnetic amplifiers. Electron regulators have been applied as speed regulators with tachometer feedback on cellulose-acetate film-casting machine drives, on plastic film or sheet extruder drives, and on wire insulating machine drives to match capstan speed to extruder speed.

The magnetic amplifier regulator combines some of the characteristics of both the rotating and electronic amplifier in that it uses reactors consisting of magnetic cores on which are wound both power output windings and control windings, and it is a controlled rectifier inserted in the line between the A.C. supply and the load.

Magnetic regulators have been applied to provide current limit acceleration and tachometer feedback speed regulation on aircarft tire and brake test-machine drives and have been applied in combination with dancer operated rotary inductor as loop position regulators on tread cooling conveyor drives and opaque plastic-film machine drives.

E. F. Meihofer, of Dobeckum Co., in commenting on Mr. Montgomery's paper, said he had found in the plastic plant of his company that of its 101 production machines, 83 used some form of electronic device for regulation and control, with 64 of these machines depending to some extent on electronics for either control of, or power for, D.C. drive motors. He said he was impressed with the record of reliability of these electronic devices.

Special features of regulator application to the plastics industry, such as those encountered in winding cellophane or acetate films, were reviewed.

V. O. Johnson, U. S. Rubber, also commented on the Montgomery paper from the rubber industry viewpoint. In some applications, it was said, inherent characteristics of a drive may be sufficiently accurate without the complication and expense of a special regulator. For tension control, slip clutches and brakes of different kinds, some requiring a certain amount of manual supervision, have been used.

Mr. Johnson inquired if the advantages of magnetic amplifiers did not outweigh their disadvantages in the majority of cases; what was the future of transitors in the field of electronic amplifiers in industry; and whether transistors could be combined with magnetic amplifiers, thus utilizing the low-maintenance and long-life aspects of both to produce a super-amplifier with all the advantages of both the electronic and magnetic devices.

The **"Report of Special Committee on Problems Due to Atmospheric Contamination,"** by E. L. Smith, Firestone, chairman, was presented at the morning session on April 5. This new special committee resulted from a discussion in the Subcommittee of the effect of the atmospheric contamination that exists around the electrical equipment in plants in the rubber and plastics industries.

The effect of carbon black in the atmosphere of rubber plants is one of the major concerns of the special committee. The increased volume of carbon black used and the increased conductivity and tendency toward agglomeration of the furnace blacks have resulted in increased clogging of the ventilation ducts and passages in the open motors in rubber plants. Periodic cleaning of motors with compressed air has not been an adequate solution to motor failure due to carbon black contamination. Forced ventilation of the motors with outside air was not completely satisfactory either because of the difficulty of providing clean air.

Water cooled, totally enclosed motors have been developed to reduce the failures due to contaminated atmosphere, but the higher cost of these motors is intensifying the search for a more economical solution.

The special committee has developed a form for reporting motor failures which it is using to collect data aimed at determining the weak points in motor designs and applications. The chairman urged the utmost cooperation from the industry in order that the special committee's work might be productive in reducing motor failures which are due to atmospheric contamination.

"A.C. Motors in Rubber and Plastics Industries—Application and Design Considerations," by C. E. Miller, General Electric Co., followed Mr. Smith's report. The major requirements and operating conditions of A.C. motors driving heavy processing machines in the rubber and plastics industries are for torques of 125% starting, 125% pull-in, and 250% maximum or pull-out. In the case of open roll machines, emergency stopping in accordance with established safety codes is required. Efficiency and power factor are evaluated on large drives, but it appears that many other factors are much more important. Carbon black contamination of motors was also mentioned by Mr. Miller as a major operating problem in the rubber industry.

Basic principles and fundamentals of induction and synchronous motors, including starting current, torque, efficiency, and dynamic braking were discussed in some detail, and it was then pointed out that changing one motor constant in order to improve a characteristic affects several other characteristics, sometimes adversely, and compromises have to be made. This speaker concluded with a plea for mutual understanding between the motor supplier and user, since with such understanding there are benefits for all.

R. H. Clarke, Goodyear Aircraft Corp., commented on Mr. Miller's paper with special reference to A.C. motors in the plastics film industry. He reviewed the manufacturing steps involved and explained that mixer batch sizes of proper volume and weight to insure maximum mixing efficiency sometimes result in overloads large enough to stall the mixer motors. When necessary, larger motors have to be installed, and protection against powders in the atmosphere, plasticizer effect on insulation, etc., have then to be considered.

Motor installations on warm-up mills and intensive mixers were explained, with reference to their ratings and loads.

Herbert F. Hepler, The B. F. Goodrich Co., in his comments on Mr. Miller's paper first pointed out synchronous motors require rugged mechanical construction of the squirrel-cage starting windings when these motors are built with high pull-in torque. Also, such motors should not be used where numerous successive starts are necessary, or production difficulties may be expected.

Mr. Hepler emphasized the importance of specifying the proper external field resistance for motor applications. On motors where starting and pull-in torque is critical, proper selection of the external field resistor can prevent operating failures, he said.

"Automatic Control Centers for Industrial Processes," by Paul Dickey, Bailey Meter Co., was the final paper on the program. The design of a control center for a process plant must incorporate the owner's operating philosophy, and this is

determined by the type of plant, type of load, background, and experience of operating personnel, Mr. Dickey said. To assure that the operator will have opportunity to use judgment and experience most effectively during start-up, emergency operation, and overall supervision, he must be provided with a compact control center.

Mechanical design of panels for control centers includes the earlier concept of a vertical panel board with indicating and recording instruments mounted on the upper portion of the board with control apparatus beneath the instruments. A later concept, now gaining considerable favor, is the bench-type panel for control apparatus and associated indicating instruments, with a vertical panel for recording instruments.

Recent developments in miniature indicating instruments provide for tremendous concentration of indications in small space and the use of "pointer patterns." These patterns give the operator a picture of normal conditions at a glance without the necessity of reading individual pointers. There are also many places where closed-circuit television can be of service, it was added.

The new recording instruments make it possible to combine practically any kind of a measurement on the same circular chart with as many as three other widely different measurements. A new inking system has been developed which allows numerous pens with different colored inks to write simultaneously on the same chart without blurring or intermingling of records.

The new techniques of data processing and scanning are not likely to change operating centers materially, the speaker said. They will, however, provide fast resolution of complex problems for quality control. We can expect extension of data processing in this field, Mr. Dickey concluded.

Plant Trip

An inspection trip through The Timken Roller Bearing Co.'s plant at Canton, O., was made by many of those attending the Subcommittee on Rubber & Plastics, AIEE, Conference on the afternoon of April 5.

The trip included such departments as the electric furnace, piercing mill, rolling mill, bearing grinding, and manufacture.

Polymer Irradiation Effects Subject of Joint Meeting

A joint meeting of the Northeastern Section, A. C. S., and its Elastomer & Plastics Group at the Massachusetts Institute of Technology, March 10, participating in a symposium on atomic radiation of polymers, was addressed by A. M. Bueche, General Electric Co., on "Chemical and Physical Effects of Irradiation," and Dennis Robinson, High Voltage Engineering Corp., on "Radiation Sources."

The increasing interest in the effects of high energy radiation on polymers has stemmed from three main investigatory sources, Mr. Bueche said. These are the search for polymeric materials that can be used in the presence of high energy radiation, the probing of the possibility of modifying the physical and chemical properties of polymers by means of radiation, and the study of general radiation chemistry that has proved more facile with polymers than with low molecular weight materials.

Although the theoretic effect of irradiation is either the cross-linking or the degradation of the polymer, increasing the molecular weight in the first case and decreasing it in the other, in actual practice both processes have occurred simultaneously. Absolute control of these processes has so far proved impossible, Mr. Bueche said, but it can be assumed that what results depends largely upon the details of the polymer structure and the density of ionization.

Witness to the construction-destruction effect of radiation is polyethylene. Here the examination of the evolved gases and the absorption spectra of the irradiated polymer has shown that degradation of the carbon-carbon bonds has occurred with the release of hydrogen gas and small amounts of hydrocarbons. At the same time it was seen that internal double-bonds had been formed. Other polymers examined have followed this pattern.

Mr. Bueche pointed out that large differences exist in the efficiencies of cross-linking or degradation, depending upon the details of chemical structure. Aromatic groups in polymers, for example, seem to be particularly effective in reducing these efficiencies, he said.

High energy radiation, by providing a means of introducing known members of cross-links into a polymer without the introduction of foreign chemicals, has proved useful in the general study of the physical properties of polymers. This factor is particularly advantageous where the products of the normal chemical cross-linking reaction lead to instability of the polymer, Mr. Bueche concluded.

Examining the development of radiation sources, Dr. Robinson declared that until the advent of atomic energy and the technological progress associated with it the only available radiation sources were X-ray machines, radium, and particle accelerators known in popular jargon as "atom-smashers." Even with these limited research tools, he said, investigators foresaw such industrial possibilities as the vulcanization of rubber without sulfur through irradiation.

Today the most suitable and economical form of machine-produced ionizing radiation for processing is a high-intensity beam of electrons traveling at almost the speed of light, with energies of several millions of electron volts. Devices in this category that have proved most practical include the Van de Graaff electrostatic accelerator, the resonant transformer, the capacitron, and various types of cascaded and pulsed transformer systems. At present, drug sterilization, for example, would cost about 3-5¢ a pound with these devices.

Commercially more expensive would be nuclear radiation for such purposes, even with the waste products of nuclear reactors, and the speaker did not believe such a technique was currently of value on a business level, although he did not rule out the possibility that it could become practical in the future.

D. W. Kitchin, Simplex Wire & Cable Co., presided over the symposium. C. S. Marvel, University of Illinois, gave an evening address on the physical chemistry of polymers, but a report of his talk is not available at this time.

Rogers and Lindskog Address Tlargi

"Elastomeric Foam Materials" was the subject of a talk given by T. H. Rogers, The Goodyear Tire & Rubber Co., Akron, O., before 100 members and guests of The Los Angeles Rubber Group, Inc., meeting at the Hotel Statler, Los Angeles, Calif., March 1. Also scheduled to speak was Russell B. Lindskog, scientist and lecturer, whose topic was "Atomic Energy in the Coming Era."

The consumption of latex foam rubber has increased from 18,000,000 pounds for the best pre-World War II year to 175,000,000 pounds in 1954, with 200,000,000 pounds expected to be consumed in 1955, Mr. Rogers said. More than 40% of the current consumption was attributed to the automotive industry, 30% to the furniture industry, and, in descending order, mattresses, public seating, and pillows absorbed the remainder of the latex foam rubber.

The various types of natural and synthetic rubber latices used in foam were discussed, as well as the components and characteristics of natural-synthetic blends. Mr. Rogers cited figures to show that excellent compression-weight factors were obtained by increasing the percentage of synthetic rubber in these blends; while the stress-strain values decreased at the same time.

Vinyl and polyurethane foams were described next, and their physical properties compared with those of latex foam. Finally, Mr. Rogers reviewed expanded and closed-cell types of foams and gave his impression of the sponge rubber market as a whole.

J. S. Buehler, Midland Rubber Corp., presided over the technical session. Door prizes, contributed by Kirkhill Rubber Co. and distributed by R. L. Wells, Firestone Tire & Rubber Co., were won by Chuck Findlay, Shell Oil Co.; Harold Terry, Master Processing Corp.; Gene Ostman, P. B. Division of Byron-Jackson Co.; Joe Stetina, Triangle Tool & Machine Co.; Bert Biheller, H. Muehlstein & Co.; B. R. Snyder, R. T. Vanderbilt Co.; B. R. Reese, B. F. Goodrich Industrial products Division; William Ireland, Firestone; and Joe Bearce, Caram Mfg Co. Master of ceremonies was R. L. Short, Kirkhill Rubber.

New York Rubber Group Addressed by Coe, Servais

The New York Rubber Group, meeting April 1 at the Henry Hudson Hotel, New York, N. Y., was addressed by John P. Coe, vice president of United States Rubber Co. and chairman of the board of Texas-United States Chemical Co., both of New York, on the subject of "What Can We Expect with the GR-S Program?" Also featured on the meeting's program was P. C. Servais, Dow Corning Corp., Midland, Mich., whose topic was "Compounding Properties and Applications of Silicone Rubber." Attendance at the technical session was 250 members and guests.

Mr. Coe's talk dealt with the history of synthetic rubbers in the United States, from their development in the 1930's, through the invaluable part they played in the winning of World War II, to their recent passing from monopolistic government control into the hands of 15 private companies representing the pooled interests of 52 firms.

Synthetic rubber started as an enforced substitution for the natural product, but its evolution was so rapid that by 1948, Mr. Coe pointed out, such rubbers as oil-resisting neoprene and acrylo rubbers, non-bouncing Butyl, and GR-S tire tread compounds could not be substituted for in the industrial economy. Simultaneously, by 1954, 1¼-million tons of rubber, or half the worldwide figure, were being consumed in the United States, and the inadequacy of the natural rubber supply made the use of synthetic a necessity.

Congress passed the Disposal Act in 1953, but the law was not to see fulfillment for almost two years. Primary obstacle was the government's high asking price for the plants. The actual cost of the plants was $488,600,000 and the government was asking a total of $285,500,000 for them, or 60% of their cost, far in excess of the 37% figure under which the government had sold its aluminum plants, Mr. Coe declared.

With the government garnering a $32,-000,000 average annual profit from the operation of the synthetic plants, half of which would have to go for income taxes under private ownership, 4% profit on a $400,000,000 investment would normally accrue to private companies, hardly an incentive, Mr. Coe thought. The plants, however, were purchased.

"I really think those who bought the plants generally went beyond the ordinary rules which must be applied to raising venture capital, and they did this in order to break the government monopoly and to get the industry free," he stated.

As to the future of the industry, Mr. Coe expressed cautious optimism. The 23¢-a-pound figure agreed upon was too low, he believed, with 24¢ or 25¢ being a more equitable selling price. In the matter of squeezing out small companies from their share of production, a possibility members of Congress had suggested, this speaker felt this was a distortion dictated by partisan politics. Naugatuck, for example, he said, had promised to sell 50-60% of its production to others than United States Rubber Co. and its associates, and he was certain other companies would follow a similar pattern.

One loose end remains before the Disposal Act can be completely fulfilled. There have been no takers for the Baytown copolymer plant in Baytown, Tex., and, accordingly, the government will continue to run these facilities until they are sold.

The total objective of the synthetic rubber industry now, an industry which Mr. Coe termed, "the largest commercial chemical development in our history," is to produce two billion pounds of rubber a year. Among other things, this volume will have a stabilizing effect on the price of natural rubber, a good thing, he thought, since American rubber consumers have always been at the mercy of powerful speculators operating in Singapore.

P. C. Servais, discussing the chemistry and applications of silicone rubber, reviewed the essential characteristics of the four compounding ingredients: silicone polymer, filler, additives, and vulcanizing agent. The dimethylsiloxane polymer was characterized by resistance to change at high and low temperatures, oil, corona, ozone, and weathering. The polymer could be modified by the replacement of some of the methyl groups with phenyl groups, improving low-temperature performance.

Replacing some of the methyl groups with vinyl groups makes possible sulfur-type vulcanization of the polymer, Mr. Servais said, facilitating blending and co-vulcanizing with organic rubbers and bettering the processibility and resistance to heat, cold, and weather.

Fillers, primarily inorganic oxides, determine such properties as hardness, tensile strength, elongation, and tear strength, he continued, and additives are utilized for color, heat stability, low compression set, and sponging. Applicable vulcanizing agents include such strong organic peroxides as benzoyl peroxide, tertiary butyl perbenzoate, and dichlorobenzoyl peroxide.

Northeastern Section Tours Natick QMC Laboratories

The Elastomer & Plastics Group, Northeastern Section, A. C. S., toured the new laboratories of the U. S. Army Quartermaster Corps at Natick, Mass., April 12, and were briefed on current research and development activities there by scientists of the Corps' chemical and plastics division. Present were 230 members and guests.

J. Fred Oesterling, chief of the chemicals and plastics division, described the work being done by his own section, as well as that of the other divisions at Natick, including the dispensing and handling equipment, fire and protection, mechanical, pioneer, and textile, clothing and footwear divisions.

The laboratories of these divisions were inspected on the tour. Researchers explained essential equipment and outlined work-in-progress. In the rubber laboratory the development of an oil-resistant, low-temperature Kel-F elastomer was described, and the many polymers evaluated during the past year were enumerated. In the plastics laboratory a new development in air-delivery molded pallets, nestable and built around cellotex or balsa wood, was exhibited, as well as fiberglass boat-sleds with laminated phenolic runners.

After the tour the Group assembled in the Corps' auditorium to hear talks by Juan C. Montermoso, chief of the rubber section, and J. Alden Murray, chief of the plastics section, on research activities in their departments.

Dr. Montermoso revealed that the Corps' latest work was with fluorine and silicone-polysulfide rubbers, but these were presenting difficulties in curing. Special monomer syntheses were also being carried out, with material development contracted out to private companies and evaluations conducted by this section. A study of the biosynthesis of rubber to assist the development of improved synthetic rubbers was another aspect of his section's program, he said. Much research was also being done in trying to develop an arctic-type rubber resistant to oxidizing agents.

Dr. Murray pointed out that his section was not concerned with the development of new plastics as much as trying to find new applications. Plastics, he said, were important to the military because they were non-critical materials and could be produced quickly and in great quantities. Now under study were such practical commodities as dishware, buttons, sleds, snowshoes, skis, foot lockers, parachute boxes, typewriter cases, field desks, pallets, packboards, air-delivery platforms for jeeps and trucks, and hard-wearing chevrons.

Ontario Hears Servais

P. C. Servais, Dow Corning Corp., addressed the Ontario Rubber Section, C.I.C., on "Compounding and Fabrication of Silicone Rubber" at Pickfair Restaurant, Mimico, Ont., Canada, April 12. The preparation, properties, and uses of silicone rubber were discussed,[1] and a related film, "What Is a Silicone?", was shown.

Election of the group's officers was held. They include W. H. Bechtel, Kaufman Rubber Co., Ltd., chairman; G. Grushcow, Dayton Rubber Co. (Canada), Ltd., vice chairman; Wray Cline, Canadian General Tower, Ltd., secretary; and Carl Croakman, Binney & Smith, Ltd., treasurer.

The next session of the Ontario Section will be the annual International Meeting held jointly with the Buffalo Rubber Group at the Hotel Brock, Niagara Falls, Ont., May 20. This will be held on the same day and in the same hotel as a meeting of the Rubber Division, C.I.C. M. E. Lerner, editor, *Rubber Age*, will address the International Meeting on "General Observations of the Rubber Industry in Europe."

[1] See report of similar talk before the New York Rubber Group, above.

Akron Group Textile Symposium and Dinner-Meeting

Akron Beacon Journal

Part of the speaker's table at the Akron Rubber Group, April 1 meeting: left to right, seated: V. L. Petersen, James A. Farley, M. H. Leonard; standing, left to right: R. P. Whipple and William Williams (Akron Coco-Cola Co.)

Attendance at the Akron Rubber Group's April 1 symposium on "Textiles and the Rubber Industry," and its dinner-meeting, both held in the Mayflower Hotel, Akron, O., was at the usual level of between six and seven hundred members and guests.

The technical program in the afternoon was arranged by a committee headed by R. P. Whipple, Firestone Tire & Rubber Co. Milton Leonard, Binney & Smith Co., a member of Mr. Whipple's committee, presided at the beginning of the afternoon session and then turned the meeting over to T. M. Kersker, Firestone, moderator for the panel discussion. Panel members participating in this program follow: W. L. Smith, The B. F. Goodrich Co.; Phil W. Drew, Goodyear Tire & Rubber Co.; L. W. Reeves, General Tire & Rubber Co.; Arthur Baker, American Viscose Co.; Russell Petersen, E. I. du Pont de Nemours & Co., Inc.; H. S. Grew, Wellington Sears Co.; and John Hagen, Callaway Mills, Inc.

Each member of the panel gave a short talk on some special phase of the subject of textiles and the rubber industry, following which questions submitted in advance were answered. The talks and the panel discussion will be published in a future issue of RUBBER WORLD.

At the dinner-meeting in the evening, presided over by V. L. Petersen, Goodyear, Group chairman, it was announced that membership now totaled 1,681. James A. Farley, chairman of the board, Coca-Cola Export Corp., and former Democratic national chairman, was the after-dinner speaker. His subject was, "What Is Our Mission in the World Today?"

Mr. Farley said that he was one of a number of American political leaders who believe the United States has a world mission. We did not seek this mission and frequently tried to avoid picking up the huge check implied in having a mission; but history handed it to us. The American mission is primarily moral rather than military, and although we may have to defend ourselves by force, ultimate victory will come by conversion rather than conquest, he added.

We must continue to make democracy work at home, and we will have to work with the world as it is and not as we think it ought to be. We shall not achieve a community of nations at peace merely through strength; but it is perfectly clear that we shall never achieve it without strength, it was said.

The success of the United States was attributed to the way we throw thousands of free minds against problems in politics, business, education, and science. Because of this fact Mr. Farley said he did not think a third world war will be attempted; and if it is attempted, he has no doubt of the result.

In conclusion, it was said that America's mission is still to demonstrate that free government is workable not only for the United States, but for the world. Internationally we must, in strength and not in weakness, work toward a community of nations steadily developing a wider common base in morals and in law.

Stevenson, Neal Address Boston Rubber Group

Two hundred members and guests of the Boston Rubber Group, meeting at the Hotel Somerset, Boston, Mass., March 25, heard addresses by Arthur C. Stevenson and Arthur M. Neal, both of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., on "Isocyanate Elastomers" and "Hypalon Solution Coatings," respectively.

Dr. Stevenson traced the historical development of isocyanates and outlined the chemical structure, properties, typical reactions with water and polyhydric substances, and applications of these materials as they are available today. Polyurethane foam, one such application, was shown to be particularly valuable in terms of resiliency in that a two-pound block of it has about 50% more load-bearing capacity than a six-pound block of natural rubber/GR-S foam.

The chemical and physical properties of "Adiprene" B, a urethane rubber, were then discussed. The abrasion resistance of "Adiprene" B was said to be so high that tire treads made of it outwear normal tire treads by as much as three times. Urethane rubber was expected to make inroads into such fields as oil field supplies, mechanical goods, footwear, and cut thread.

Dr. Neal described the structure and properties of "Hypalon" as they influenced solution processes; he pointed out the absence of the need of plasticization, the freedom from color restrictions, and the special requirements for an adequate curing system and for freedom from moisture in all ingredients.

The preferred method for preparing solutions is to dissolve the "Hypalon" directly in the solvent, adding the pigments as ball-milled or paint-mill-ground dispersions, he said. Such solutions can be sprayed, dipped, or brushed. Tri-basic lead maleate is the preferred curative because of its low density, adequate but safe cure, longer storage life, and better color stability, although optimum color requirements can be better achieved with magnesia.

Applications for these and other "Hypalon" preparations were enumerated, including coating of other elastomers, coating of fabrics, and coating of metals to impart chemical resistance to strong acids, alkalies, and sea water.

Edwin D. Covell, Stedfast Rubber Co., presided over the meeting. Membership of the Boston Group is now 858, it was reported. After-dinner speaker was Arthur B. Monroe, whose subject was "Behind the Scenes with the Criminal Investigator."

Rhode Island Club Meets

The meeting of the Rhode Island Rubber Club, at the Pawtucket Country Club, Pawtucket, R. I., March 31, was addressed by William C. Kindelan, Department of Social Welfare, Penal & Correctional Institutions, Howard, R. I., on the operations of the Rhode Island Prison and the Providence County Jail, of which he is warden. Attendance totaled 173.

Roy G. Volkman, United States Rubber Co., was appointed club historian until a constitutional revision can create such a permanent office.

Bureau of Standards Holds Open House

The National Bureau of Standards, United States Department of Commerce, held an Open House in Washington, D. C., for several hundred leaders in the fields of science, industry, government, and education, February 7-11. Recent developments in the science of measurement were exhibited, and guided tours of 16 of the Bureau's laboratories were conducted.

The event stressed the significance of physical measurement standards to scientific and industrial progress. Featured were a first showing of two new radiation facilities, the NBS Betatron and Gamma Ray Laboratories; the announcement of a system for so-called X-ray televising of the internal parts of an operating engine; and the demonstration of a radiation monitor for atomic blasts.

Participating in the program were Secretary of Commerce Sinclair Weeks, Under Secretary of Commerce Walter Williams, Director of the Bureau Allen V. Astin, and members of the Bureau's technical staff.

The Bureau also revealed newly built precision equipment for measuring the properties of fibers, yarns, and fabrics under high-speed impact. These are intended to assist industry and government in the solution of basic technical and scientific problems in the development, production, and specifications of fibrous materials. Automobile and tire cords, for example, must withstand high impact forces; and in industrial sewing, thread must stitch efficiently without breaking under strains repeated 5,000 times per minute.

The new Gamma Ray Laboratory will allow the Bureau to meet increasing scientific and technical demands growing out of advances in the use of atomic energy. Before radioactive materials and instruments for their detection can be used safely and effectively, they must be calibrated against the radioactive standards maintained by the Bureau. In recent years, the Bureau says, cobalt 60 has been increasingly used in place of radium for industrial X-ray photography, instrument calibration, and medical treatment. The new laboratory will accommodate the growing demand for cobalt 60 calibration.

The Betatron Laboratory will house the Bureau's 50-million-volt betatron and its 180-million-volt synchroton. The X-rays produced by these high-energy electron accelerators will be used to develop the standards and measurement methods needed for safe application of high-energy X-rays in industry, nuclear physics, and medicine. Exact wall thicknesses and optimum types of construction for protection from these radiations can be determined through laboratory research, the Bureau says.

Dr. Astin presented a lecture-demonstration on "Physical Standards—the Cornerstone of Scientific and Industrial Progress." This was a broad survey of the Bureau's functions in developing the precise standards of measurement required by modern science and industry and was illustrated by the actual operation of various pieces of equipment, such as the national standard bar and kilogram, the radiation monitor, apparatus for X-ray televising the interior of an engine, and the pattern amplifier.

The X-ray televising demonstration employed betatron radiation in combination with a technique recently developed at the Bureau for converting high-energy X-rays into visual images. The moving piston of a small one-cylinder engine, as well as the piston rod and other parts, was clearly seen in the televised X-ray image.

Cyanamid Acrylonitriles In Medium-Scale Quantities

The installation of special facilities for the intermediate commercial production of more than 20 derivatives of acrylonitrile, as well as other new products, at its Bound Brook, N. J., and Warners, N. J., plants has been announced by American Cyanamid Co., New York, N. Y.

The new installations are intended to supply these products to consumers in larger than pilot-plant, but smaller than full-scale commercial quantities. This policy will allow other industrial companies to proceed with their own development programs with assurance of adequate supplies, Cyanamid declares. It will also broaden Cyanamid's production experience with these chemicals as a prelude to the eventual construction of commercial plants.

Other advantages of this intermediate production technique are said to be the shortening of time required to bring a product from the research laboratory into profitable commercial production, the permitting of important economies in introducing new products to industry, and the minimizing of management's risk when it decides on plant additions to produce new products.

Technical snarls that cannot be revealed in pilot-plant production, but that may crop up in large-scale manufacture, may possibly be discovered, the company asserts. Also, a sounder appraisal of market potentialities is brought closer with medium-quantity output.

The Warners installation includes general manufacturing facilities; while equipment for hydrogenation and other high-pressure reactions is located at Bound Brook. Cyanamid is currently producing acrylonitrile at its Fortier, La., plant.

Plan Chemical Exposition

The twenty-fifth Exposition of Chemical Industries will be held at the Commercial Museum and Convention Hall, Philadelphia, Pa., December 5-9, according to E. K. Stevens, manager of the International Exposition Co., 480 Lexington Ave., New York 17, N. Y., which is arranging the event.

The exposition will cover the contemporary application of chemistry and chemical engineering to industry. The last such affair was held two years ago. More than 300 requests for exhibition space have so far been received.

ASME Hears Drake on Passenger Conveyor Belts

E. L. Drake, Philadelphia district manager of Stephens-Adamson Mfg. Co., Aurora, Ill., the firm that designed the passenger conveyor belt that will link the Times Square and Grand Central stations of the New York City subway system, gave an address on "Belt Conveyors for People" before the Diamond Jubilee spring meeting of the American Society of Mechanical Engineers at Baltimore, Md., April 18.

He traced the development of the belt-conveyor transportation principle during the past half-century and described the many such projects now being planned in Texas, California, Ohio, and New York for underground, overhead, and street-level use at speeds up to 15 miles an hour.

He revealed, for example, that Cleveland, O., is studying the possibility of a beltwalk that would encircle the business district and provide a link with the central surface transportation system. A city in Texas is also considering the construction of an overhead beltwalk that would pass through major stores and office buildings.

Detailing the features of the proposed Times Square-Grand Central shuttle, the first conveyor belt designed to replace a subway-car system, Mr. Drake said that it will provide smooth, quiet, rapid, and safe transportation for New York City's millions. When this prototype will have proved itself, a new approach to urban transportation problems will have been effected, he added.

To Give Polymers Course

An intensive course for scientists and engineers on the properties and structures of high polymers in solution will be given by the University of Michigan, Department of Chemical & Metallurgical Engineering, Ann Arbor, Mich., July 18-23.

To be covered will be such subjects as the basic concepts of the structure and configuration of large molecules; behavior of high polymers in solution; experimental measurements, including those for viscosity, light scattering, infrared absorption, sedimentation and diffusion, and osmotic pressure; and the interpretation of data.

Lectures, discussions, and laboratory work will be conducted by the following: L. M. Hobbs, associate professor of chemical engineering, University of Michigan, and director of Michigan-Memorial Phoenix Project on Elastomers; F. Bueche, associate professor of physics, University of Wyoming; L. H. Cragg, professor of chemistry, Hamilton College, McMaster University; Samuel Krimm, assistant professor of physics, University of Michigan; Robert Simha, professor of chemical engineering, New York University; and S. G. Weissberg, chemist, National Bureau of Standards.

Registration will be accepted until May 18 and will be limited to 50 persons. Correspondence should be addressed to L. M. Hobbs, Department of Chemical & Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

Washington Group Programs

John M. Ball, Midwest Rubber Reclaiming Co., addressed the Washington Rubber Group, meeting in the Pepco Auditorium, Washington, D. C., April 20, on "The Manufacture and Importance of Reclaimed Rubber." Following his talk, a movie, "Behind the Scenes," describing the manufacturing operations of Midwest's East St. Louis plant, was shown.

An amendment to the Group's constitution to merge the offices of secretary and recording secretary was voted upon and approved.

"New Trends in Polyethylene" was the subject of a previous talk given by John Brown, Spencer Chemical Co., at the Group's March 16 meeting in the Pepco Auditorium. Asserting that the polyethylene supply is finally catching up to the enormous demand, Dr. Brown estimated that consumption of the material in 1957 will have reached the 600-million-pound level.

Polyethylene, a thermoplastic hydrocarbon chemically related to paraffin, but stronger and with a higher melting point, is currently being produced by the high-pressure polymerization of purified ethylene through the conventional free-radical reaction. Several grades of varying molecular weights are made; the greater the molecular weight the more heat resistant the final product.

Dr. Brown sees a growing future for the material. New varieties and physical forms will be developed, he said, paralleling the history of vinyls. Studies on polymer structure and polymerization techniques are bearing fruit in producing polyethylene polymers of greater heat resistance and expanding utility, he concluded.

Harrington Discusses Diisocyanates before SORG

C. J. Harrington, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., gave a talk on "Diisocyanates" before the March 31 meeting of the Southern Ohio Rubber Group at the Engineers Club, Dayton, O., at which 125 members and guests were present.

Dr. Harrington dwelt briefly on the origin and chemistry of the polyurethanes, taking note of the fact that the development of nylon, involving the building up of long-chain compounds from difunctional organic materials, led indirectly to the creation of commercially valuable diisocyanate materials. In this connection, he said that polyurethane fibers and filaments have been made experimentally and may one day take their place alongside the synthetic fibers now on the general market.

"Adiprene" B, du Pont's new polyurethane rubber, was then discussed in detail, including technique of manufacture, chemical and physical properties, and applications. Polyurethane foams, both rigid and resilient, followed similarly. Dr. Harrington was optimistic about the future of these foams, expecting them one day to permit labor saving and new design in the fabrication of new products with properties heretofore unobtainable.

Chairman of the meeting was Joseph Rockoff, The Dayton Rubber Co. Speakers at the business session included James R. Wall, Inland Mfg. Division, General Motors Corp.; and Frank Newton, Dayton Rubber.

Brooklyn Poly Courses

The Polytechnical Institute of Brooklyn will conduct the twelfth in its annual series of summer laboratory courses and associated lectures beginning June 6. The program was created to meet the demands of working scientists and technicians for advanced and intensive instruction on the use of specialized physical tools in chemistry and physics.

The three courses scheduled include "Progress in Polymerization and Copolymerization Techniques," June 6-10; "Properties of Macromolecules in Solution, Including Polyelectrolytes and Other Water Soluble Polymers," June 13-17; and "Industrial Applications of X-Ray Diffraction," June 6-17.

Inquiries should be addressed to Mrs. Doris Cattell, Secretary, Summer Laboratory Courses, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y. Assistance in obtaining accommodations in the vicinity will be given all registrants upon request.

CALENDAR of COMING EVENTS

May 17
Elastomer & Plastics Group, Northeastern Section, A. C. S. Massachusetts Institute of Technology, Cambridge, Mass.

May 18
Washington Rubber Group, Potomac Electric Power Co. Bldg., Washington, D. C.

May 20
Connecticut Rubber Group.
Buffalo Rubber Group. Joint Meeting with Ontario Rubber Section. Hotel Brock, Niagara Falls, Ont., Canada.
Rubber Division, C. I. C. Annual Meeting. Hotel Brock, Niagara Falls.

May 30-June 1
Chemical Institute of Canada. Thirty-Eighth Annual Conference. Quebec, P.Q., Canada.

June 2
Rhode Island Rubber Club. Outing. Pawtucket Country Club, Pawtucket, R. I.

June 3-5
The Los Angeles Rubber Group, Inc. Summer Outing. Hotel del Coronado, San Diego, Calif.

June 4
Southern Ohio Rubber Group. Summer Outing. Inland Activities Center.

June 9
New York Rubber Group. Annual Outing. Doerr's Grove, Millburn, N. J.

June 10
Fort Wayne Rubber & Plastics Group. Summer Outing.

June 12-17
Society of Automotive Engineers. National Meeting, Golden Anniversary Summer Meeting. Chalfonte-Haddon Hall, Atlantic City, N. J.

June 16
Buffalo Rubber Group. Summer Outing. Lancaster Country Club.

June 17
Akron Rubber Group. Summer Outing. Firestone Country Club.
Boston Rubber Group. Summer Outing. Andover Country Club, Andover, Mass.

June 19-23
American Society of Mechanical Engineers. Diamond Jubilee. Semi-Annual Meeting. Boston, Mass.

June 24
Detroit Rubber & Plastics Group, Inc. Summer Outing.

June 26-July 1
American Society for Testing Materials. Annual Meeting. Chalfonte-Haddon Hall, Atlantic City, N. J.

August 19
Philadelphia Rubber Group. Annual Outing. Manufacturers' Country Club, Oreland, Pa.

September 11-16
American Chemical Society. National Meeting. Minneapolis, Minn.

September 22
Southern Ohio Rubber Group. Fall Technical Meeting. Engineers Club of Dayton, Dayton, O.

October 4
The Los Angeles Rubber Group, Inc., Statler Hotel, Los Angeles, Calif.

October 5-9
World Plastics Fair & Trade Exposition. National Guard Armory, Los Angeles, Calif.

October 7
New York Rubber Group. Henry Hudson Hotel, New York, N. Y.

Details of Akron Symposium on Plastic and Rubber Foam—I

The October 22, 1954, joint fall meeting of the Akron Rubber Group and the Cleveland-Akron Section of the Society of Plastics Engineers at the Mayflower Hotel, Akron, O., featured a symposium on "Plastic and Rubber Foam," and the remarks of the seven panelists are reported below. Presided over by J. N. Street, The Firestone Tire & Rubber Co., the panel consisted of R. A. Maurer, Kenmar Mfg. Co.; H. Beckerlag, Fisher Body; T. H. Rogers, The Goodyear Tire & Rubber Co.; William Manring, B. F. Goodrich Chemical Co.; W. H. Ayscue, E. I. du Pont de Nemours & Co., Inc.; William Schock, Dow Chemical Co.; and Robert Courtney, Bakelite Corp. Questions and answers follow the remarks of the speakers.

Rubber and Plastic Foam in the Furniture Industry

R. A. Maurer
Kenmar Mfg. Co.

I am going to restrict my remarks to the part of the industry of which I have some knowledge. Many problems of the bedding industry differ from those of the upholstered living-room field. I will also have to limit my remarks to latex foam, since I know of no major use of plastic foam in our industry as of this time.

Our company is in its second period of latex foam use. The first was during the middle Thirties, but demand disappeared because of relatively high cost in a low-price market. Demand is stronger now. Compared to conventional seating, latex foam has as its greatest advantages comfort and near-indestructibility.

The following improvements would make the material still more marketable: First, in molded cushion form, more resistance to compression laterally and less resistance to compression horizontally are needed. Most customer complaints revolve about cover wrinkling or crawling and too much resistance to compression. Second, improved porosity to allow better circulation of air around the body is required.

Actually, our greatest problem is the large differential in cost for latex foam over conventional filling materials. We are sure that the volume usage of rubber foam in the upholstered field would increase in relation to its decreasing ratio of material cost to total product cost.

One sofa we are currently selling retails at $125 with spring cushions, and $169 with latex foam cushions. Reduction of this difference would not only mean that more foam cushions would be used, but that foam material with the right properties could be used in place of all other filling materials. Summarizing these optimum properties, they are lack of permanent set, correct porosity at both the surface and throughout the material, correct resistance to compression, resistance to normal home cleaning fluids, and lightness of material.

Rubber and Plastic Foam in the Automotive Industry

H. Beckerlag
Fisher Body

As in all other materials, the use of foam rubbers or foam plastics in automotive applications is controlled by factors of cost *versus* suitability. Foam rubber products never have been and probably never will be inexpensive, even in volume, and their use is therefore restricted to places where their properties overrule all else.

Until recently, the only significant application of foam rubber in automobiles has been in upholstery where load distribution properties, resilience, and durability can be used to advantage in the construction of premium quality seating.

Residual odor is a possible defect of these foams. This may be due to insufficient washing by the manufacturer or the reaction of solvents used for cleaning upholstery trim.

The nature of the foam forming process places some limitations on the shapes and sizes available and the tolerances required, but it is much less limited in this respect than expanded cell stocks. For rubber foams, we are using sections as small as 1/16-inch thick and as large as three inches. With mold cast forms, fairly complex shapes are possible since the obvious limitations of pressure mold parting lines are eliminated.

Foam rubber is not applicable to direct exposure to weathering or scuffing, but with a protective coating it has been found practical on our mechanically retained door-weatherstrip seals. Here the material is being compounded to its best physical properties, such as comparatively low compression set, high resiliency, and low load deflection. The result is a very flexible strip which follows body contours and, because of its inherent softness, is not subject to internal tears at high stress areas.

Another development brought about by styling requirements is embossed trim. In this use a cover material such as leather or vinyl coated fabric is applied over a foam rubber pad, and the desired design achieved by means of heat and pressure. This usage has great possibilities for interior automobile designs. Another major use of foam rubber is as backing on automobile carpets; thus fabricated, the carpet can drape over contours without wrinkling.

Plastic foams, both elastic and rigid, have found application as armrest and instrument panel pads. Expanding sealers of the foaming type may also one day be developed for automotive use. In the same category, but somewhat out of the automotive field, is the foamed-in-place plastics, which can be used for structural rigidity.

Diisocyanate compounds are the most recently developed foaming materials. The extraordinary physical properties and good aging resistance of both the foam and rigid types make close examination by industry imperative, despite current high costs of the materials.

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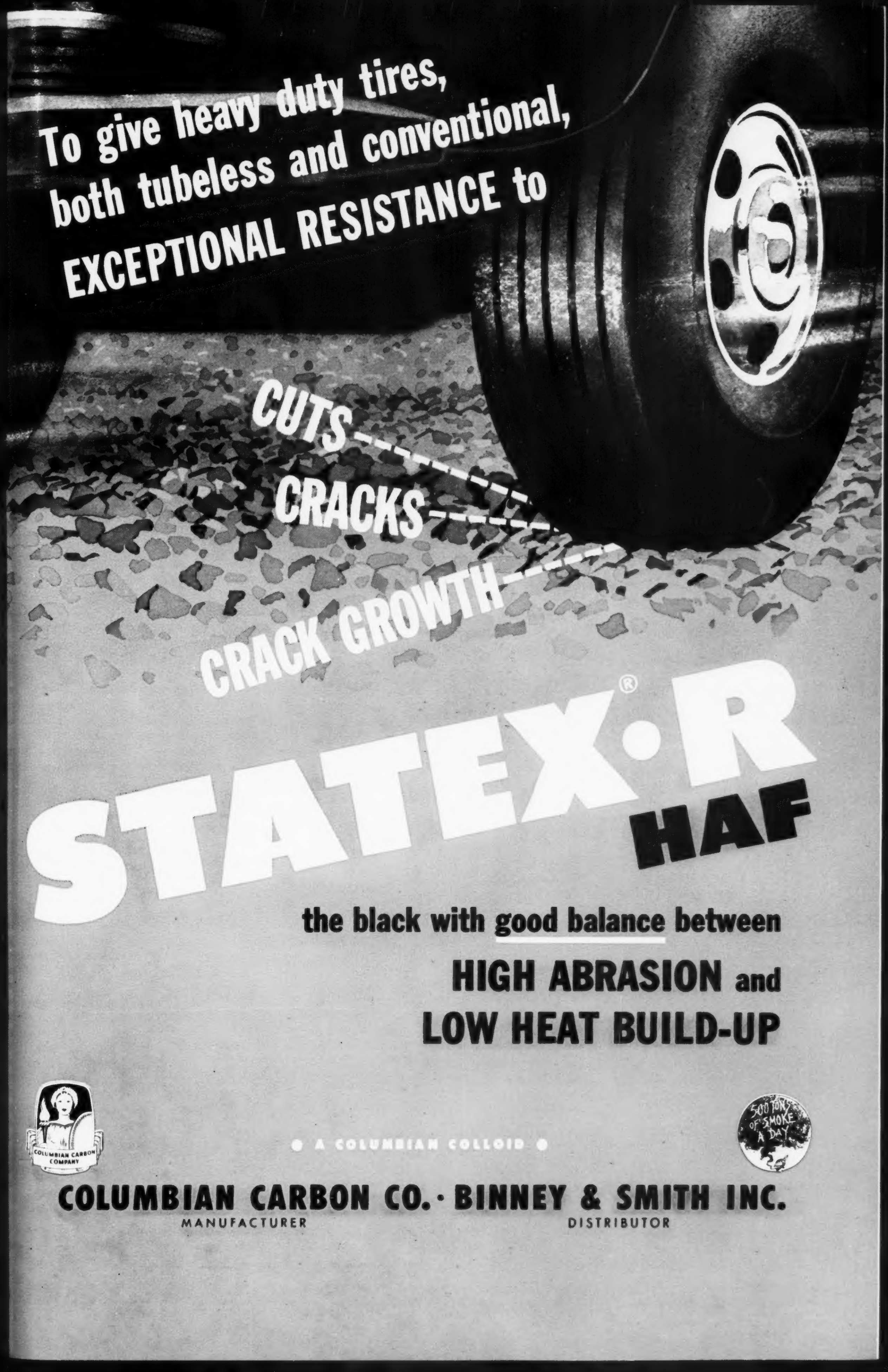
To give heavy duty tires,
both tubeless and conventional,
EXCEPTIONAL RESISTANCE to
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HIGH ABRASION and
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COLUMBIAN CARBON COMPANY
500 TONS OF SMOKE A DAY
A COLUMBIAN COLLOID
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The Latex Foam Industry

T. H. Rogers
The Goodyear Tire & Rubber Co.

T. H. Rogers

Until just a relatively few months ago the latex foam industry ruled supreme. Then two newcomers came galloping over the horizon to challenge it with such claims as lower cost, greater non-inflammability, and better aging. I am completely familiar with all the characters in the plot, for I have worked with them in the laboratory. First let me minimize the confusion by defining terminology.

The cellular elastomeric materials, which may be considered a generic term, broadly include those products which contain cells, or small hollow receptacles, and these products are capable of elongation or compression and return to their original shape. Included here are latex foam rubber, sponge rubber, expanded rubber, flexible expanded plastics, and other materials.

Essentially, two different processes are used to make latex foam rubber. One is the Dunlop method. The other is the hydrogen peroxide freezing method, usually referred to as the Talalay process. The Dunlop method, used by most producers, consists of the introduction of air into the liquid latex, the jelling of the mass by either reduction of pH with an acid salt such as sodium silicofluoride or by precipitation of a very fine particle-size mass which results in a large increase in the specific surface, and the subsequent destabilization and jellation of the rubber particles by the resultant paucity of soap in the system.

With rubber particles the cohesion of one particle to another is very great, and a tough film around the bubble is thus formed. With a further decrease of pH brought about by the continued solubilization of the sodium silicofluoride, the soap itself is decomposed to its fatty acid constituents, and a gradual shrinking takes place. This can readily be observed by putting the ear to the surface of the foam where crackling and popping sounds can be heard. The foam is then ready for curing, washing, drying, and trimming.

The Talalay process consists of incorporating into the compounded latex hydrogen peroxide and a catalyst which activates the decomposition of the hydrogen peroxide. The latex is poured, and after the foaming is completed, the mass is frozen, resulting in a partial breakdown of the bubbles. Carbon dioxide is then passed through the frozen mass, resulting in a firm, jelled structure. Vulcanization, washing, and drying are handled in much the same way as in the Dunlop process.

Compression is the most essential characteristic of the material. This may be increased by increasing the quantity of rubber and decreasing the volume of air. Some progress has been made in increasing the compression of latex foam by the use of resin latices, fillers, and some reinforcing agents.

Aging life of the elastomer is the next important characteristic to consider. Many of the mattresses we first produced in 1936 are still giving good service. With the improvements in antioxidants in compounding, currently produced foam should be even better in long-term aging.

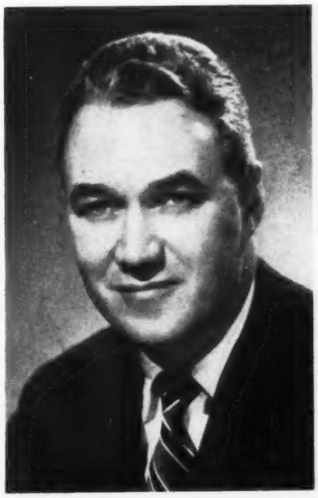
The inter-connected cellular structure of latex foam rubber enhances the breathing and moisture elimination of the body coming into contact with it. This property has undoubtedly been the biggest factor in its universal acceptance as a cushioning medium. All one has to do is cover a foam rubber cushion with a moisture and gas impervious material such as vinyl or rubber sheet, and he will soon feel the discomfort to the body arising from the sealing off from the porous surface.

Other advantageous properties of latex foam rubber include high resistance to fungicidal and bactericidal properties, excellent flex life, good stress-strain characteristics, fine low-temperature performance, resistance to solvents, good compression set, and excellent resiliency. On the debit side is the fact that latex foam rubber burns, making its use inadvisable in certain specialized applications. The newcomers in the foam family have better non-flammability.

The latex foam industry has been one of almost continual expansion since its beginning in the middle Thirties. It progressed from an 18-million-pound business for the best pre-war year to more than 160 million pounds in 1953. Based on market distribution of latex foam rubber in 1950, automotive use accounted for 45%, furniture and miscellaneous applications for 25%, mattresses for 17%, public seating for 10%, and pillows for 5%. The market continues to expand.

Polyvinyl Chloride Foam and Sponge

William Manring
B. F. Goodrich Chemical Co.



William Manring

Do the newer vinyl and polyester-isocyanate foams offer a serious commercial challenge to foam rubber latex? Token investments in research and development time and in capital equipment are being made to uncover reliable information about the practicality of the newer products and their processing, and in many instances the expenditures have gone well beyond the token stage. Enough presumptive evidence is available to encourage the belief that the vinyl and the isocyanate foams will create their own markets, based on their inherent properties.

I will restrict my remarks to the expanded, cellular polyvinyl products. First, to define terms, closed cell or unicellular expanded polyvinyl chloride we call sponge, and open or interconnecting cell polyvinyl chloride products we call foam.

Closed-cell vinyl is a well-established commercial product ranging in degrees of firmness from soft to rigid. The good properties of this material include light unit weight, chemical and oil resistance, toughness, age resistance, insulation value, and optional non-flammability. Some applications are for fish-net floats and buoys, life-saving equipment, industrial uses where contact with chemicals and fuels is encountered, and electrical applications where permeability to X-rays is necessary.

Closed-cell vinyl sponge is made by dispersing a chemical blowing agent in a vinyl resin/plasticizer/stabilizer mixture. In its commonest form, the vinyl resin/

(*Continued on page 266*)

NEWS of the MONTH

Washington Report Summary

Excitement and optimism prevailed at the plant transfer ceremonies which took place between April 21 and 29, when 24 synthetic rubber plants were turned over to private industry. Synthetic rubber has now grown from "cradle to full stature" and joined the ranks of America's flourishing private industries, as one industry leader put it.

Meanwhile the Baytown, Tex., GR-S plant was put on the auction block again, and transfer of this plant to private ownership by mid-summer is a good possibility. The plant will be kept in operation by Federal Facilities Corp. until a final decision is reached.

GR-S and Butyl rubber inventories transferred with the plants have been listed as to types and locations so that consumers will know where to obtain their supplies. Four types will still be available from FFC from the Baytown plant.

The Senate Small Business Committee in a report dated March 29 called for a government investigation and measures "to prescribe for the competitive ills which beset the small tire dealer."

P. W. Litchfield, Goodyear Tire & Rubber Co. chairman, stated that with the transfer of the synthetic rubber facilities from government to private control and ownership, the rubber industry as a whole enters a bright and promising new era.

New rubber consumption in the United States reached a new high in March with 134,987 long tons used, according to The Rubber Manufacturers Association, Inc. W. S. Richardson, The B. F. Goodrich president, predicted a first-half consumption of 730,000 tons.

Interesting new figures on the United States rubber industry production, employment, and expenditures for new plant and equipment for the years 1949-1953 were released by the United States Department of Commerce.

U. S. Rubber, General Tire, and Seiberling signed new working conditions contracts with the URWA, CIO.

Washington Report

By ARTHUR J. KRAFT

Plant Transfers Accomplished; Excitement and Optimism at Ceremonies

Between April 21 and 29, 24 synthetic rubber plants were transferred from government to private ownership, setting off a competitive race for the rubber consumer's dollar which will be carried on at a pace never before seen in this country.

The excitement, the optimism attending the ushering in of this new industry was evident everywhere that rubber industry executives convened. It also carried through the ranks of the petroleum and chemicals companies which bought into a major share of the war-built government enterprise. The government came in for well-deserved praise for carrying synthetic rubber through its infancy and nurturing it to adulthood—from the "cradle to full stature," as one industry leader put it. The government, happy to relinquish ownership, also took some $310 million, most of it as immediate cash payment, and handed over title to the plants, plus rubber inventories and miscellaneous equipment to the 16 firms which took over the plants last month.

Louisiana Ceremonies First

Fittingly, the first plant transferred was the 47,000-ton Butyl plant purchased by Esso Standard Oil Co. The Government Disposal Commission journeyed from Washington to Baton Rouge, April 20, to sign over the deed for the plant and accept Esso's $15,962,000 in certified checks for the plant and miscellaneous items, including inventory. The following morning, with industry leaders, members of Congress, government officials, and others looking on, the transfer ceremonies took place at the 315,000 barrel-a-day Esso refinery center in Louisiana's capital city. A similar gathering took place shortly before noon a stone's throw away at the site of the copolymer and butadiene plants purchased for $11,185,208 (with more than $1 million for inventory, etc.) by Copolymer Corp., newly renamed Copolymer Rubber & Chemical Corp. After lunching with (and on) C.R.C.C., the Commission and a group of well-wishing camp followers took the short air-hop to Lake Charles, near Louisiana's western border, where on the following morning title was transferred to two more plants, the 99,600-ton (to be increased to 113,000 tons) GR-S copolymer plant purchased by Firestone Tire & Rubber Co. for $13,136,612 and the adjacent 60,000-ton butadiene plant purchased by Petroleum Chemicals, Inc. (Cities Service and Continental Oil) for $18,264,878.

The reason given for holding these ceremonies in Louisiana was a "quirk" in Louisiana's law—the Napoleonic Code handed down from the days of French sovereignty—requiring that the signing of deeds in real estate transactions take place in the parish (county) in which the property is located. There are some attorneys who will dispute this. No one, however,

At the banquet in Baton Rouge, La., April 20, 1955, commemorating transfer of Butyl plant to Esso Standard Oil Co., left to right: O. V. Tracy, general manager of Esso Chemical Products Division and president of Enjay Co.; Leslie R. Rounds, Disposal Commissioner; Eugene Holland, executive director, Disposal Commission; H. J. Voorhies, vice president, Esso; Holman D. Pettibone, Disposal Commission chairman; and Everett R. Cook, Disposal Commissioner

regretted the fact that, for whatever the reason, the transfer ceremonies on Louisiana soil provided an opportunity for making an impressive event of the occasion.

(The Commission returned to Washington to resume transferring the remaining 19 plants to their 12 new owners throughout the following week. In contrast to the Louisiana signings, the proceedings in Washington were fairly cut-and-dried, though no less important.)

Butyl Plant Transfer

The ceremonies in Louisiana got under way shortly after the Commission's arrival in Baton Rouge, with a banquet tossed by Esso to mark the transfer of ownership of the Butyl plant on the morrow. The food was good. So were the after-dinner remarks of the five speakers. Taking first things first, here's the "Menu" provided at the "Diner Butyl d'Esso"—

Toastmaster H. J. Voorhies, the Esso vice president who runs the nation's largest petroleum refinery here, recalled for the audience that it was William Jeffers, then the government's "Rubber Czar," who at the dedication of the Butyl plant here in 1942, called Baton Rouge "the cradle of the synthetic rubber industry." In the intervening years, Mr. Voorhies remarked, "synthetic rubber has grown from the cradle to full stature. It can now join the ranks of America's flourishing private industries."

Elmer D. Conner, executive-director of the Louisiana Department of Commerce & Industry, followed this theme and pointed out the importance to his state's economy of having an expanding private synthetic industry within its boundaries.

Esso Director O. V. Tracy, who came down from New York to head his firm's delegation at the transfer proceedings, hailed the occasion as the "beginning of a new chapter in the industrial development of the United States." He recalled Esso's early start with Butyl, Buna S, and Buna N at Baton Rouge and the simultaneous research at the Bayway, N. J., refinery during the late 1930's and up to that day in 1941 when the government stepped in

MENU

Diner Butyl d'Esso

Huîtres Bienville à l'Isobutylene

Salade verte, fractionnée

Bifstek sirloin au jus d'isoprene

Pommes de terre à Brabant de catalyste

Parfait à la tour de rerun

Demi-tasse oxydée à la slurrie polymerisée

to take over and expand the Baton Rouge plants as the nucleus of the wartime synthetic rubber program. Butyl, he said, played a key role in keeping our military aviation aloft to fight toward victory.

Mr. Tracy expressed confidence in the future of Butyl, despite the severe loss of its postwar inner-tube market to the new tubeless tire. Butyl, he predicted, will find its way into a great variety of rubber products and "within a year or two" perhaps, into tires themselves. [The Butyl tires on Mr. Tracy's automobile already have run up more than 40,000 miles.]

Esso's role in what eventuated as the wartime rubber program was reviewed by another dinner speaker, John P. Coe, vice president of United States Rubber Co., owner of the small N-type rubber plant at Baton Rouge, and president of Texas-U. S. Chemical Co., which will run a Port Neches GR-S copolymer plant and share in the ownership (with Goodrich-Gulf Chemicals) of the giant butadiene plant there. Mr. Coe paid the ultimate tribute to Esso, after recalling that it was that firm's parent, Standard Oil Co. of New Jersey, which brought to these shores the first knowledge of synthetic rubber manufacture in the 1930's—the early research and patents developed by the German I. G. Farbenindustrie.

"Our synthetic rubber industry," said Mr. Coe, "is based on technology brought to this country by Standard Oil. It got started in synthetic rubber on its own initiative and at its own expense. When the war came, Standard Oil taught the rest of us how to build rubber plants and make rubber."

Frederick Machlin, treasurer of Copolymer Rubber & Chemical Corp. and president of Armstrong Rubber Co., presenting checks for purchase of the Baton Rouge, La., facilities to Leslie R. Rounds, Disposal Commission treasurer, on April 21, 1955. H. P. Schrank, vice president of Copolymer and of Seiberling Rubber Co., is at left

Mr. Coe recalled that Standard's transactions with the German firm, at a time when the Nazi regime was growing in power and talking war, was strongly criticized by many in this country who failed to foresee, as had Esso, the vulnerable position of this country's rubber supply—the Far Eastern natural rubber plantations—should war come. Standard Oil weathered these "unfair" attacks, Mr. Coe said, and gave us the know-how which played a vital and indispensable role in our victory over the Axis powers only a few years later. We might well have lost that war had not Standard Oil made its deal with Farben, he declared.

"It's about time," Mr. Coe added, "that we acknowledge our debt to the Standard Oil Co."

Disposal Commission Chairman Holman D. Pettibone wound up the evening with a tribute to the "business statesmanship of those companies which bought the rubber plants," declaring that this was the key element making the success of the disposal program. Synthetic rubber, he declared, "is a going, essential, and profitable enterprise" with a sound future.

Firestone and Petroleum Chemicals, Inc.

The following evening, Petroleum Chemicals and Firestone officials, tendered a banquet at Lake Charles, with F. M. Simpson, vice president and general manager of P.C.I. acting as toastmaster. Speakers included J. E. Trainer, executive vice president of Firestone, Congressmen T. A. Thompson and Overton Brooks, both of Louisiana, and Mr. Pettibone. At the Esso plant signings, both Brooks, the ranking Democrat on the House Armed Services committee, and Representative James H. Morrison, of Baton Rouge, reviewed the committee's role in setting up and finally approving the rubber plant sales program.

Copolymer Rubber & Chemicals Corp.

Rep. Brooks, Mr. Pettibone, E. D. Kelly, director of the Office of Synthetic Rubber, Federal Facilities Corp., were guest speakers at the ceremonies at Copolymer Rubber & Chemical.

Copolymer's president, A. L. Freedlander, and the firm's executive vice president, C. M. Hulings, manager of the Baton Rouge plants, also addressed the gathering. The ceremonies at Copolymer were launched when Mr. Pettibone snipped a symbolic strand of red tape draped over the entry gate to the plant site. With title papers in hand, Copolymer's management immediately called in construction crews to break ground on new facilities aimed at expanding the plant's capacity.

Baytown GR-S Plant on Block Again; FFC Continues Operation

The Rubber Producing Facilities Disposal Commission, for the second time within two years, last month put the Baytown, Tex., GR-S copolymer plant on the auction block. Acting under special legislation, the Commission on April 1 announced its readiness to receive proposals to purchase the government-owned facility. Also offered for sale or lease were 447 government-owned tank cars. Bidding deadline was set for April 29.

Both were reoffered for disposition following failure of the original disposal program, carried out over a 13-month period which ended last December, to bring forth satisfactory bids for either the 44,000-ton-a-year Baytown plant or the tank cars. The General Tire & Rubber Co., operator of Baytown copolymer, entered the lone bid for the plant—but its price of $2.4 million was deemed too low by the Commission.

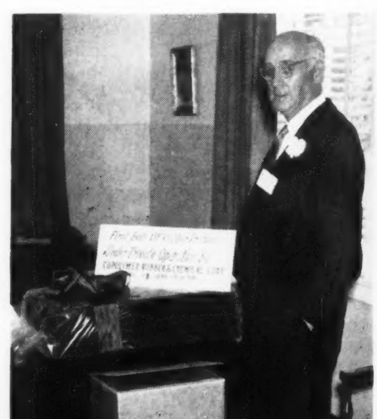
Whether General will submit a new bid on this second go around is conjectural. The only announcements of bidding intentions on the record prior to April 1 were from the Baytown Rubber & Chemical Co., formed by local interests to buy the copolymer plant, and an offer from Cities Service Oil Co. to lease a number of the tank cars. There were reports that General might put in a joint bid with some chemical company, and other reports it would not bid and was making independent arrangements to obtain GR-S required in its rubber fabricating operations. There were reports, too, that New England industrial interests might offer to purchase the Baytown facility.

January Transfer?

Once the bids are in, the Commission will negotiate for a period not to exceed 60 days on the proposals received. Thereafter a 10-day period is provided for the Commission's report to Congress, which has, in turn, 30 days to review the recommendations and, should it wish, upset whatever contract of sale the Commission might come up with. The Attorney General must pass on the Commission's recommendations from the standpoint of the anti-trust laws.

If the disposal of the Baytown plant is stretched out to the full period permitted under the law, it would be mid-July before the sale was wrapped up—assuming Congress is still in session at that late date to review the contract.

If Congress were to adjourn, it could delay matters until next January. Barring unforeseen difficulties, however, the Com-



C. M. Hulings, executive vice president, Copolymer Rubber & Chemical Corp., with first bale of GR-S produced under private operation

mission is hopeful that negotiations can be concluded in less than the maximum 60-day period allowed and that Congress will grant its approval before the summer leave-taking of legislators from Washington.

FFC Baytown Operation Continued

Meanwhile the Baytown plant will be kept in operation by the Federal Facilities Corp. FFC announced in mid-April that it would take orders for delivery during May and for succeeding months until further notice. Purchase orders (except for May shipments) must be in FFC's hands before the twelfth day of the month preceding delivery.

The agency said it will continue to produce and sell the four types of GR-S polymers made at Baytown over the past two years—GR-S 1600, 1601, 1602, and 1801. As of mid-April, the agency had lined up sufficient butadiene and styrene to run the plant "at a pretty good clip" (close to 3,500 tons a month) during May and June. If necessary to operate beyond that, the agency was prepared to look for additional feedstocks to do so. The feedstocks assured to FFC for May and June come from two sources—small amounts from several firms which have purchased government butadiene plants and leftover residual inventory in FFC's hands. The butadiene plant operators are supplying FFC on a month-to-month contract basis.

GR-S and Butyl Inventories Listed

Along with the announcement offering to sell Baytown-produced GR-S starting in May, the FFC issued a circular to all current buyers of GR-S and Butyl rubbers listing the types of GR-S which each plant purchaser will acquire from final FFC inventory. (See page 264.) Under the disposal law, all GR-S left in FFC's hands on April 29—the final day of plant transfer—was to be sold at once to purchasers of the rubber plants.

FFC estimated that it ran out the program April 29 with somewhat less than 35,000 tons of GR-S on hand, along with 8,000 to 9,000 tons of Butyl. However, those plants transferred to their new owners prior to April 29 (the first transfer took place April 12) were still producing rubber and had an opportunity to accumulate inventory of their own. Thus FFC believes another 10,000 to 15,000 tons may be accumulated by private producers on top of the 30,000 to 35,000 tons they will receive on April 29 from FFC. That accumulation means a total GR-S inventory of from 40,000 to 50,000 tons will be available when private synthetic rubber operation gets under full swing at the end of April. This compares with March sales —a record high—of 69,000 tons and April sales somewhat shy of that figure. The end-of-program Butyl inventory of nearly 9,000 tons compares with current monthly sales of about 5,500 tons.

Tire Selling Investigation Urged

The Senate Small Business Committee, in its annual report issued March 29, urged a sweeping federal investigation and government measures "to prescribe for the competitive ills which beset the small tire dealer."

"In any such investigation," the Committee suggested, "primary stress should properly be placed on the effect of manufacturer-owned stores on competitive practices within the industry. In this connection, study should be made of the adequacy or inadequacy of independent tire dealers' margins."

The Committee, headed by Sen. John Sparkman (Dem., Ala.), urged the Senate to act on a pending bill aimed at curbing "the inroads of manufacturer-controlled retail outlets on dealers' sales." This bill, which would bar retail tire sales by manufacturers or large petroleum and chain-store outlets, has been introduced in every Congress since 1942.

"The prospect of an entire retail segment of an established multi-billion-dollar industry facing decimation is a matter which cannot be viewed with tranquility," the strongly worded report declared.

"Currently, the nearest relief for independent tire dealers seems tied to the pending quantity-limit discount ruling which is in litigation. Court approval of this ruling would go a long way toward balancing the competitive scales among independent dealers of all sizes and between independent dealers and mass-merchandising outlets," the Committee asserted.

The Committee complained, however, about the exclusion of company-owned stores from the Quantity-Limit ruling, promulgated by the Federal Trade Commission several years ago. It described this exclusion as a "loophole in the order's general effectiveness which requires further study" by the FTC. It also urged the Justice Department to "expedite court action on this case which is so vital to the welfare of small businessmen."

The report summed up the Committee's case against manufacturer-owned stores in these words:

"Your committee . . . has concluded that company-owned stores enjoy an additional and unmerited advantage over independent dealers arising from the circumstance that the stores are not purchasers but consignees. The manufacturers' excise tax on rubber tires is 5¢ a pound and on tubes 9¢ a pound. Manufacturers pass this tax on to the dealers, collecting from dealers when the merchandise is invoiced and title to the tires and tubes changes hands. In the case of company stores, however, the tax is not paid until a sale is made to a consumer because the company stores receive the merchandise as a consignee. This manufacturers' tax, therefore, bites into the slender working capital resources of the small dealer without similar effect on company-owned stores. To your committee this specific competitive advantage is unfair and is a subject which unquestionably requires further study."

The Committee also urged an FTC field investigation of the extent to which the United States Rubber Co. has complied with the terms of the consent decree entered 15 years ago. Under that decree the company was ordered to cease and desist "from selling at discriminatory prices, especially where sales through company-controlled outlets to large commercial accounts injured competition between the respondent and retail tire dealers competing with company stores." A field investigation of compliance "at this time might have salutory results throughout the industry," the Committee said.

In addition, the Committee expressed concern over the survival of the smaller tire-producing companies and quoted at length from a rather gloomy (the Committee called it "candid") letter addressed to stockholders by J. P. Seiberling, president of Seiberling Rubber Co., reviewing the first nine months of 1954 [the tire business picked up sharply later in 1954, after a protracted poor stretch through much of 1954—AJK].

On this point, the Committee declared: "The year 1954 will go down as one of the most fiercely competitive periods the rubber industry has ever struggled through. Price wars, always sporadic in the industry, last year reached epidemic proportions. And at the same time that costs were soaring, tire production fell substantially below the 1953 figures . . . Your committee is aware that the problems of the tire industry are not confined to the small dealers. Some executives in the smaller tire-producing companies are speculating whether their companies will be in business 10 years from now. The mortality figures fail to reassure. In 1920 some 300 companies produced rubber tires. Today, only a score of concerns are turning out tires and tubes."

In line with this commentary, the report quoted from the Seiberling letter, and for further buttressing of their argument, the authors of the Senate report noted that net income after taxes of the Big Four rubber companies fell 7.4% last year, while that of the smaller companies dropped 31.9%.

Synthetic Labeling Bill Again

One of the hardy perennials among those bills that never get very far is back again. Representative Davis of Georgia has re-introduced a bill in the House to require that "all articles of wearing apparel and all articles intended for personal use in frequent or sustained contact with the skin of the user, which contain or are composed, in whole or in part, of synthetic rubber" be so labeled.

Under the Davis bill, H.R. 4917, the job of prescribing labeling standards and registering the products would be handed to the Federal Trade Commission. Purpose of the bill is to inform consumers whether such articles contain synthetic rubber.

In hearings on the bill in the last Congress, Mr. Davis contended that some people are sensitive—or allergic—to synthetic rubber on contact. Medical advisers on the staff of rubber manufacturers testified that no cases of sensitivity to the rubber, as fabricated in products, have been turned up in their experiments with large numbers of users. They pointed to the possibility that persons claiming sensitivity to synthetic rubber were suffering

from sensitivity to other chemicals, added in manufacturing finished articles. Rubber manufacturers, they said, have taken pains to eliminate from their products all materials known to cause allergic reactions.

The Davis bill was referred to the House Interstate and Foreign Commerce committee.

National News

Bright Era for Rubber—Litchfield

P. W. Litchfield, chairman of the board, Goodyear Tire & Rubber Co., believes that with the passing of this nation's synthetic rubber facilities from government to private control and ownership, the rubber industry as a whole now enters a bright and promising new era. Never before has the industry been in such a favorable position to bring boldness and confidence to its forward planning. Price and supply, the underpinnings of the industry, have gained a new firmness. Hazards to our national security have been materially relieved.

These statements and others were included in another of Litchfield's "Notes on America's Rubber Industry," entitled "A New Look for Rubber," which was published in late April.

The key word in the new look for rubber is stability, Litchfield added. As matters now stand, synthetic and natural rubber are interchangeable within very broad limits, and only small segments of our total output of rubber goods call specifically for natural *versus* synthetic, and *vice versa*. We can maintain high product quality so long as we can obtain natural rubber for 25% of our total needs, and the minimum requirement for synthetic rubber would be about the same ratio to the total.

Synthetic rubber facilities now in private ownership have an estimated total capacity (all types) of 984,000 long tons per year, plus 44,000 long tons when the Baytown plant is sold. The annual capacity of existing rubber tree plantings is estimated at 1,850,000 long tons. Foreign synthetic plants have an estimated capacity of 140,000 long tons. Thus the total available supply of new rubber is on the basis of 3,018,000 long tons per year. Current world demand was placed at 2,705,000 long tons a year, which means that the balance between supply and demand is delicate. The balance is temporary, however, as planned expansion of synthetic rubber producing capacity will be created and available in advance of the need.

Litchfield urged that the government immediately create the necessary incentives through service and price arrangements to encourage private industry to acquire a substantial part of its needs for natural rubber from the government stockpile, rather than through direct importation. The grades in the stockpile are not so uniform as those obtained by importation, but should be gradually improved by close government-industry cooperation in rotation of these stocks.

It was also urged that sufficient natural rubber plantings be made in the Western Hemisphere to yield a supply adequate for minimum needs in time of emergency and that a synthetic rubber stockpile be accumulated as a matter of national policy.

These problems of proper maintenance and handling of our stockpile, the creation of a rubber growing program in the Western Hemisphere, and a synthetic rubber stockpile are not to be minimized, it was said in conclusion. *These problems differ from our traditional problems in that they are not beyond our own control—we can manage them, and we will manage them*, Litchfield emphasized.

Continued Growth Prospects Called Good

In two reports released during March and April, Standard & Poor's statistical service in New York took the position that the outlook is quite promising for further growth in the rubber fabricating industry.

The "Tire and Rubber—Basic Analysis," report of March 31 said that prospects for tire sales appear favorable for an extended period ahead. Eventually, however, sales will again be subject to wide cyclical fluctuations, and the adverse effect of lower shipments on earnings is likely to be aggravated by the recurrent price wars characteristic of the industry.

A greater degree of stability in operating results in future years, however, was considered possible because the earnings base of many companies has been broadened by development of new products and markets in fields such as chemicals and plastics, foamed rubber, and industrial items.

Moreover, with the shift of rubber to the category of a relatively stable, low priced raw material with the advent of synthetic rubbers and now with their transfer entirely to private industry production, these factors will encourage processors to develop new products and enter fields previously barred by price uncertainties.

Non-tire lines were said to have particularly promising growth prospects since these activities are newer and less concentrated, and wage rates are lower than in the tire building field. In addition, markets are more diverse, and margins are wider than those obtainable from tire sales. Over the longer term, more than half of total industry sales and a larger proportion of profits are likely to be derived from non-tire lines.

In a "Tires and Rubber—Current Analysis," report of April 14, Standard & Poor's suggested that quarterly variations in the industry are likely to become less marked than usual. Seasonal factors will favor final-half sales of replacement tires, while original equipment tires will reach their peak in the first-half, with a similar showing indicated for industrial lines. Growth in or the addition of new lines will further tend to iron out fluctuations.

Profits improvement should be general this year, aided by larger volume and some upward price adjustments, it was said. Dividends for the industry as a whole will exceed those of 1954 by a wide margin, it was predicted.

1950-1953 Industry Trends

According to recent releases of the Bureau of Census on the rubber industry, as reported by the Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce, in the tire industry, the "cost of materials, fuel, electricity and contract work," after rising sharply in 1951, declined through 1953, despite record consumption of rubber in that year. Salaries and wages rose each year from 1950 through 1953. In 1952-1953 the balance remaining after subtracting salaries and wages from "value added by manufacture" was less than in 1950-1951. For the 1950-1953 period this balance, out of which taxes, interest, payments, and profits have to come, accounted for 47.5% of the value added by manufacture in this segment of the industry, it was said. The federal tire and tube excise taxes alone amounted to $690,102,000 for the four years, or 21.7% of the value added by manufacture.

In the other segments of the rubber industry shown by Census, salaries and wages increased likewise except in the reclaimed rubber industry. The balance remaining from "value added by manufacture" after subtracting "salaries and wages" represented 35% of the former in the footwear industry, 40% in the reclaiming industry, and 42% for other rubber industries.

Total employment in the rubber industries rose to 269,780 in 1953 from 222,368 in 1949. Growth was most pronounced in the other rubber goods industry (industrial rubber products) both in production workers and salaried personnel; it is precisely this industry which has been entered by numerous new small companies, BDSA said.

Average wages per production worker were 21% greater in 1953 than in 1950 in the tire and tube and in the other rubber goods industry, 23% higher in the

footwear industry, and 8% higher in reclaiming. The corresponding increases in average "value added by manufacture" per production worker were much less: 11% for the tire and footwear industries, 1% for reclaiming, and 16% for the other rubber products industry.

Expenditures for new plant and equipment may be made from earnings or from new financing, BDSA pointed out. The amounts expended for these items by the rubber industries are reported by the Census as follows for recent years. Expansions have been greatest in the tire industry; in the other segments they had passed their peak before 1953, it was said.

RUBBER INDUSTRY EXPENDITURES FOR NEW PLANT AND EQUIPMENT

(Values in $1,000)

	Tires and Tubes		Footwear	
Year	Machinery & Equipment	New Structures & Plant Additions	Machinery & Equipment	New Structures & Plant Additions
1949	22,491	3,408	1,863	295
1950	34,721	7,508	3,245	575
1951	48,617	9,391	4,395	899
1952	61,695	11,202	2,436	794
1953	68,476	11,257	3,997	782
	Reclaiming		All Other	
1949	562	143	25,148	9,343
1950	507	28	24,541	8,833
1951	2,065	86	36,478	11,775
1952	1,049	285	37,225	12,232
1953	849	155	33,121	8,415

EMPLOYMENT IN RUBBER INDUSTRIES

	Tires and Tubes			Footwear		
Year	Total	Salaried	Production	Total	Salaried	Production
1949	87,042	16,050	70,992	24,331	3,947	20,384
1950	89,520	15,621	73,899	18,924	3,252	15,672
1951	92,244	16,512	75,732	23,813	3,555	20,258
1952	97,911	17,978	79,933	23,274	3,636	19,638
1953	97,026	17,839	79,187	25,384	3,699	21,685
	Reclaiming			All Other		
1949	2,153	285	1,868	108,842	21,750	87,092
1950	2,365	268	2,097	125,633	22,926	102,706
1951	2,696	329	2,367	134,039	25,796	108,243
1952	2,259	327	1,932	131,635	27,272	104,363
1953	2,368	355	2,013	145,002	29,034	115,968

UNITED STATES RUBBER MANUFACTURING INDUSTRIES, BY SEGMENTS

(Values in $1,000)

Year	Value of Products	Cost of Materials	Value Added by Manufacture	Salaries and Wages	Remaining Balance
		Tires and Tubes Industry			
1950	1,724,704	960,917	763,787	357,291	406,496
1951	2,067,192	1,313,559	753,633	402,966	350,667
1952	1,995,162	1,232,793	762,369	452,458	309,911
1953	2,072,738	1,167,765	904,973	462,653	442,320
		Rubber Footwear Industry			
1950	139,556	53,433	86,123	53,301	32,822
1951	211,156	97,365	113,791	73,317	40,474
1952	213,610	88,768	124,842	79,626	45,216
1953	219,520	90,860	128,660	87,549	41,111
		Reclaimed Rubber Industry			
1950	31,687	14,980	16,707	9,312	7,395
1951	41,467	23,442	18,025	11,623	6,402
1952	30,673	14,138	16,534	9,503	7,031
1953	30,272	14,100	16,172	10,403	5,769
		Other Rubber Industries*			
1950	1,318,610	576,026	742,969	411,199	331,770
1951	1,669,655	826,147	843,894	474,680	369,214
1952	1,643,605	803,594	840,396	500,579	339,817
1953	1,812,055	840,417	971,638	579,414	392,224

*For Other Rubber Industries, the published "Cost of Materials" plus "Value Added by Manufacture" does not exactly equal "Value of Products."

Source: Compiled from Bureau of the Census Annual Summaries of Manufacturing Industries.

Rubber Consumption at Record High

New rubber consumption in the United States during March, 1955, amounted to 134,987 long tons and established a new all-time monthly high, according to the April 20 report of The Rubber Manufacturers Association, Inc. The previous peak of new rubber consumption was in March, 1953, when 128,610 tons were used.

Natural rubber consumption in March of this year increased to 57,933 tons, and the ratio of natural rubber to total new rubber continued to decline, with the March ratio at 42.9%. Total synthetic rubber used during the month increased 14% to 77,054 tons.

W. S. Richardson, president of The B. F. Goodrich Co., predicted in April that consumption of new rubber in the first half of this year will total 730,000 long tons, of which 420,000 tons, or 57.5%, will be synthetic rubbers.

In the second half, he said, total consumption is estimated to decline about 15% to 620,000 tons, while natural rubber usage may drop almost 20% from 310,000 tons to 250,000 tons.

He explained that the reason why natural rubber is expected to decline at a faster rate is its continued high price, currently about 31¢ a pound for top grades, as compared with general-purpose synthetic rubber at 23¢.

Richardson attributed high first-half consumption to the "unusually large requirements of tires and other rubber products for new cars and to above-normal pattern of shipments of tires for replacement."

Although 1955 replacement tire volume is expected to be higher than that in 1954, the first half is exceeding expectations because of the introduction of new lines and dealer buying in anticipation of price increases.

Also, R. E. Davis, manager of sales research, Goodyear Tire & Rubber Co., in a talk before a regional meeting of the National Association of Independent Tire Dealers in Monterey, Calif., in April, estimated that 1,365,000 long tons of new rubber would be consumed in the United States this year, with a further increase seen for 1956.

New Union Contracts

After a one-week strike, which began March 31, the United Rubber, Cork, Linoleum & Plastic Workers of America, CIO, signed a new working conditions contract with United States Rubber Co., in New York on April 8. The company and the union had been negotiating since March 14, but did not reach agreement on a new contract by March 31 when the old contract expired. Nineteen plants of the rubber company were shut down, and about 33,000 workers stayed away from their jobs for one week. Wages were not an issue.

The new contract of two-year duration provides for an extra paid holiday and an improved vacation plan. These provisions in the new contract, however, are exactly the provisions offered by U. S. Rubber before the strike began, according to the company.

Employes will now receive seven paid holidays instead of six as formerly. The exact holiday will be selected by the URWA locals in the various plants.

Employes with 11 to 14 years of service will receive an improved vacation plan providing for one extra day's pay for each year of service beyond 10 years in addition to their regular two weeks' vacation. When employes reach 15 years of service, the full three weeks' vacation, which has been standard practice, will remain in force.

The General Tire & Rubber Co. and Seiberling Rubber Co. also signed new working conditions contracts with the URWA locals in March and April. Several minor contract changes were made, and both companies agreed to grant make-up pay for jury duty. Wages were not an issue in these negotiations, and both contracts are to extend for a period of two years.

Other Industry News

Rubber Corp. and Ross & Roberts Build PVC Plant

The Rubber Corp. of America, Hicksville, N. Y., and Ross & Roberts Co., Stratford, Conn., each prominent in the production of vinyl film and sheeting, have formed a separate Insular Chemical Corp. and are proceeding with the construction of a plant at Hicksville for the production of polyvinyl chloride resin. While heretofore the manufacture of PVC has been exclusively in the hands of the larger chemical companies, this move represents a departure in that two established PVC consumers have joined hands to secure a basic and integrated position with respect to their chief raw materials.

The major output of this new multimillion-pound resin plant will go to the two vinyl film and sheeting fabricators. Rubber Corp. of America will also act as exclusive sales agent for Insular Chemical Corp. and will thus be able to offer PVC resins, in addition to its present line of plasticizers, to its customers in the PVC field. A three-year engineering and development program which preceded the plant construction has resulted in the development of several new vinyl resins not available elsewhere, some of which may be offered on the market for special applications, it was said.

The new PVC plant will be a model of automatic control and materials handling and will incorporate the latest in engineering design. It will be completed in the Spring of 1956, but during the period between now and then activities at the existing laboratory and pilot-plant building will continue at an augmented rate. Calendering-grade resins are already available in semi-commercial quantities.

Firestone Near 100,000th Steel Wire Cord Tire

The Firestone Tire & Rubber Co., Akron, O., this month will manufacture its 100,000th truck and bus tire made with steel wire cord, according to Raymond C. Firestone, executive vice president of the firm. Not one of these tires in service has ever had a blowout, he revealed, and some users have reported as much as 300,000 miles on original treads.

The tire's fabric consists of four plies of fine high-tensile steel wire embedded in rubber; the plies are placed at alternating angles to provide maximum resistance to stress in any direction. A nylon breaker strip fabric separates the wire cord body from the tread. The four plies of wire cord are said to give greater strength than would 12-14 plies of textile fabric ordinarily used in tires of this size.

Thirteen years and more than a million dollars in research have gone into the tire's development, Mr. Firestone declared, resulting in what he believed to be the safest and strongest pneumatic tire ever built. Continuing research will soon extend the life of this tire design to half a million miles, he said.

The tire is particularly favored by bus and truck operators on the front wheels of their vehicles, with some bus lines said to be equipping all their wheels with these tires to avoid heat-type failures. The steel wire, an efficient conductor of heat, drains accumulating heat away from the tire's tread, but does not stretch in the process, applying no undue tension against the rubber tread.

Raymond C. Firestone, Firestone's executive vice president, poses with partially cutaway steel wire cord tire

Thiokol Reopens Polymer Plant

Thiokol Chemical Corp., Trenton, N. J., has reopened its polysulfide liquid polymer plant at Moss Point, Miss., after a temporary shutdown. The level of production has been boosted to exceed the highest previous rate, that existing at the time of the plant's opening in July, 1952.

Reason for the reopening is the current increased demand for polysulfide liquid polymers for such application as a sealant for integral fuel cells in aircraft, a sealer-adhesive for machine components, a potting agent for electrical parts, and a caulking material for ship's decks. The firm's main plant at Trenton also makes the material.

Goodrich Low-Pressure Tubeless Tires

A complete line of wide-base, low-pressure tubeless off-the-road tires will shortly be marketed by The B. F. Goodrich Co., Akron, O. Designed for high flotation, the tire features a modified traction tread and is expected to find application on varied types of off-the-road equipment, including tractors, bulldozers, scrapers, and other earth-moving equipment.

Prototype of the new Goodrich tire was one developed two years ago by company engineers in conjunction with R. G. Le Tourneau, president of the heavy equipment manufacturing firm which bears his name. That tire is said to be the first of its kind expressly designed to provide simultaneous flotation and traction.

Fortisan-36 Price Set

Celanese Corp. of America, New York, N. Y., has set a price of $1.50 a pound, delivered east of the Mississippi River, on its Fortisan-36 yarn, recently developed industrial rayon fiber for such high-strength applications as power transmission belting, fire hose, and conveyor belts.

Initially available will be an 800-denier size with an 0.8 twist on four-pound cones, but heavier yarns are expected to be produced at a later date. Delivery is anticipated for the end of 1955.

Braille History of Rubber

A 43-page Braille digest of "Rubber, a Story of Romance and Science," a history of the rubber industry recently published by United States Rubber Co., New York, N. Y., has been made available by the American Printing House for the Blind, Louisville, Ky. U. S. Rubber is said to be among the first companies thus to provide the sightless with educational material about American industry.

Organizations for the blind may obtain free copies of the Braille booklet from United States Rubber Co.'s public relations department, 1230 Avenue of the Americas, New York 20, N. Y.

Electronic Inventory Control System

What is said to be the first electronic inventory control system in the rubber industry will be installed at the B. F. Goodrich footwear and flooring plant, Watertown, Mass., according to Teleregister Corp., Stamford, Conn., developer of the system. Dresser Engineering, Inc., Providence, R. I., served as consultant and will supervise the installation of the system.

The equipment, called Magnetronic Inventory System, is similar in operation to the Magnetronic Reservisors now in use in the air transport industry for facilitating the handling of passenger reservations. American Airlines has been utilizing such equipment for the instantaneous determination of space availability on up to 1,000 flight legs a day.

A magnetic storage drum, nerve center of the system, retains and quickly makes available for visual and printed reference thousands of style size data, quantities on hand or committed for future shipment, and permanent records of individual transactions. Teleregister expects the system to revolutionize the concept of inventory control in a variety of industries.

Phillips Advances Eleven

W. C. Hewitt has been promoted from general operating superintendent to assistant general manager of Phillips Chemical Co., wholly owned subsidiary of Phillips Petroleum Co., Bartlesville, Okla. Also advanced were A. J. Head, to director of the Bartlesville manufacturing division, and A. B. Leonard, to director of the rubber chemicals division.

G. H. Short has been named to replace Mr. Leonard as plant superintendent of the Plains butadiene and copolymer synthetic rubber facilities, near Borger, Tex., which were recently purchased from the government. Replacing Mr. Head as Philblack plant superintendent at Borger is H. E. Haltom.

Also appointed were H. D. Trotter as assistant plant superintendent at the Plains plant; C. M. Tucker, manufacturing superintendent; and L. J. Ronayne, process superintendent. At the company's Adams Terminal site, Pasadena, Tex., W. R. Pittman, now superintendent of terminaling operations, is succeeded as mechanical and maintenance superintendent by G. K. Young, replaced, in turn, as maintenance supervisor by Earl Geoffrey.

Moves Sales Offices

Three regional offices of Minnesota Rubber & Gasket Co., serving the Detroit, Philadelphia, and New York areas, have been transferred to larger quarters because of increased business volume. The new addresses are 19149 Grand River Ave., Detroit, Mich.; 8 Tanner St., Haddonfield, N. J., servicing the Philadelphia area; and 8 Riverview Ave., Rutherford, N. J., servicing the New York area.

Bancroft W. Henderson

Henderson President of American Synthetic

Bancroft W. Henderson has been elected president of American Synthetic Rubber Corp., recent purchaser of the government owned synthetic rubber plant at Louisville, Ky., according to Thomas Robins, Jr., chairman of its board and president of Hewitt-Robins, Inc., one of the new firm's major stockholders.

Also appointed to executive positions were Howard W. Cable, vice president, manufacturing; and Raymond F. Hart, treasurer. Mr. Cable was plant manager and Mr. Hart treasurer of Kentucky Synthetic Rubber Corp., the organization that managed the Louisville plant under government ownership for the past five years.

Mr. Henderson headed the rubber chemicals sales department of American Cyanamid Co., another of American Synthetic's major stockholders, for the last 20 years and was for 10 years previously a crude rubber importer.

American Synthetic is owned by 29 companies, most of them engaged in the manufacture of non-tire rubber products.

Form Amerigear-Zurn

Amerigear-Zurn, Inc., has been formed in Erie, Pa., as the national sales organization for the flexible couplings and allied power transmission products made in that city by American Flexible Coupling Co. Both firms are divisions of J. A. Zurn Mfg. Co., also of Erie.

The new organization has established sales representation in 35 marketing centers throughout the country. Major marketing will be to such industries as rubber, steel, aviation, automobile, marine, railroad, petroleum, chemical, mining, and paper making.

One of the recent developments of American Flexible Coupling is a synchronizing clutch-coupling for engaging and disengaging the main propulsion plants on the first atomic submarine, the *U.S.S. Nautilus*.

Richardson Appraises Industry

Tire shipments in the United States during 1955 will probably exceed 99,000,000 units, W. S. Richardson, president, The B. F. Goodrich Co., Akron, O., told a recent meeting of the Boston, Mass., Analysts' Society. At the same time he foresaw the continued increase in the production and use of motor vehicles, with passenger-car registration rising from the current 48,-000,000 to 57,000,000 by 1960.

Paralleling these developments will be a greater consumption of new rubber, climbing from the 1,233,000 long tons used in 1954 for all rubber goods to more than 1,500,000 long tons by 1960, he said. B. F. Goodrich, he added will keep pace with this spurred activity, investing $25,000,000 for expansion and improvements in 1955 and a total of $100,000,000 in the next five years.

Shell Chemical Appoints

A roster of appointments to Shell Chemical Corp.'s newly acquired synthetic rubber facilities in Los Angeles, Calif., has been announced by R. C. McCurdy, president of the firm. M. Voogd, manager of the government butadiene plant at Torrance, Calif., built and operated by Shell, has been named manager of the combined butadiene-styrene-copolymer facilities. Designated superintendent is G. S. Williamson, who holds the same title at the butadiene plant.

J. P. Cunningham, formerly manager of the company's product development department, New York, N. Y., has been appointed manager of the synthetic rubber sales division, with J. E. Toevs, erstwhile district chemical sales manager in Los Angeles, now division sales manager.

Other manufacturing appointments include D. A. Limerick and E. S. Martin, assistant superintendents; J. Levada, chief engineer; M. L. Sagenkahn, chief technologist; A. H. Anderegg, chief chemist; and W. C. Bevil, treasury manager.

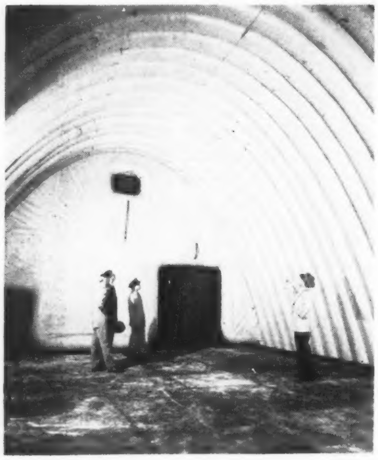
Also named to the sales division are F. W. Hannsgen, manager of sales development; H. E. Sparks, manager of distribution-operations; D. E. Fuller, treasury manager; and R. D. Sullivan, manager of technical service.

Plans Plane Tire Research

Armstrong Rubber Co., West Haven, Conn., has announced its entrance into the field of airplane tire research. Its engineers are creating new tire designs, improving materials, and planning manufacturing methods, the company reveals.

To house the equipment needed for the new research program, several buildings have been erected on the West Haven plant site, including one for developmental manufacturing and curing of airplane tires, and another that will contain a 10-foot-diameter test wheel for simulating airplane landings at speeds up to 250 miles an hour.

Rubber-Nylon Arctic Shelter Developed for Air Force



Interior of Air Force's new nylon-reinforced rubber Arctic shelter

A huge rubber inflatable Arctic ground shelter has been developed for the United States Air Force. Weighing 7,500 pounds before inflation and made of nylon reinforced synthetic rubber with an outside protective tarpaulin of vinyl-coated nylon, the erected structure forms parabolic vaulted walls and ceiling, 16½ feet high, that enclose a floor area measuring 35 by 32 feet.

Developed by The B. F. Goodrich Co. Industrial Products Division, Akron, O.; Bendix Radio Division of Bendix Aviation Corp., Baltimore, Md.; and Rome Air Development Center, Rome, N. Y., the shelter is primarily intended to house radar instruments used in tracking aircraft and has working space for 30 men.

Twenty-four arched adjoining rubber tubes, each 18 inches in diameter and filled with two pounds of air pressure, compose the shelter and provide the architectural strength to withstand 80-mile-an-hour winds and snow loads up to 24 tons. The floor consists of 24 similar air tubes upon which sectionalized plywood is laid, yielding a level surface that supports up to 100 pounds per square foot.

The interior tube surface is coated with aluminum to insulate against heat loss. Two gasoline heaters can maintain comfortable temperatures within the air-insulated shelter. A motorized blower maintains uniform pressure within the rubber arches regardless of climatic change. The two outer ends consist of 18-inch-wide, air-filled flat walls composed of inner and outer sheets of nylon reinforced rubber panels. Door openings are provided, and guy wires are strategically located to secure the entire assembly to the ground.

The assembly can be transported on a single truck or in a small military transport plane and can be erected in two hours on snow, ice, swampy or uneven ground, providing insulation against sub-zero temperatures.

Marketing Award to Evans

Thomas M. Evans, president of H. K. Porter Co., Inc., Pittsburgh, Pa., will receive the eleventh annual Parlin Memorial Award for outstanding contribution to the field of marketing, according to Edward Bloom, president of the Philadelphia Chapter of the American Marketing Association, which founded the award in 1945.

Mr. Evans will accept the citation at an AMA dinner at Philadelphia's Union League, May 18, at which time he will deliver the yearly Parlin Memorial Lecture. The application of his market techniques to his own company contributed in a large measure to its growth from a $10,000,000 sales volume in 1949 to more than $70,000,000 in sales today, the AMA says.

Basketball Washing Machine

A new type of washing machine for the removal of mold lubricant, rubber dust, talcum, and mica from rubber basketballs and softballs has been installed at its Chicopee, Mass., plant by A. G. Spalding & Bros., Inc., sporting goods manufacturer.

The machine, made by Industrial Washing Machine Corp., Matawan, N. J., rotates the balls as they are carried through a trough where chemical sprays remove impurities. A rinsing spray then washes off the chemicals. Steamheated, the machine is 15 feet long and has a processing speed of 150 basketballs or 450 softballs an hour.

All-Silicone Rubber Insulation for Large Motors

Silicone rubber stator coils for insulating large motors and generators have been developed by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The new insulating system, designated Silco-Flex, was unveiled at a joint press conference held at the Sherman Hotel, Chicago, Ill., March 30, by Allis-Chalmers and Dow Corning Corp., Midland, Mich., maker of the Silastic silicone rubber stock used.

The development, resulting from several years of research and testing, is said to represent a major achievement in insulation progress and is expected to change motor application practice in many industries. The goal of the perfect insulation, one that would never deteriorate or change in dielectric or mechanical qualities, regardless of load, during the life of the machine, is now within sight, both companies assert.

Silicones have been previously employed in rotating machines, but the silicones were generally limited to resin compounds in combination with mica and glass tape. The new all-silicone rubber insulated coils, in addition to having the high dgree of thermal endurance and moisture resistance characteristic of silicones, also exhibit the flexibility and resilience of organic rubber without that substance's rapid deterioration. The Silastic used is made from silicone rubber gum compounded with Dow Corning silica.

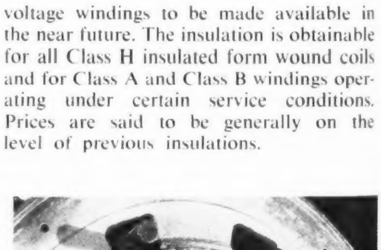
According to Allis-Chalmers, the manufacture of Silco-Flex is accomplished by applying the silicone rubber to conductors, and vulcanizing the insulation into a homogeneous mass by the application of carefully controlled heat and pressure. The result is a sealed, impervious dielectric barrier that is continuous around the coil and leads.

Other advantages cited for the system are inertness to atmospheric contaminants, weak acids, alkalies, and lubricating oils; and the improved dissipation of heat due to the high thermal conductivity of silicone rubber, resulting in cooler operating windings.

Silco-Flex is expected to improve the efficiency and lengthen the life of power plant induced draft fan motors and steel mill installations, being impervious to the abrasive dusts inherent in such atmospheres. Applications to such industries as chemical, paper, and food that formerly required totally enclosed frames will result in the use of semi-protected or open-type frames with the operating and maintenance ease accruing to such accessible structures, both companies believe.

It is also claimed that motors in cement, crushing, and similar industries will now be able to retain overload capabilities even where ventilation has been inadvertently reduced by heavy accumulation of dusts in the ventilating passages.

Being built are large machines in the 2300- and 4000-volt insulation class wound with Silco-Flex insulation, with higher voltage windings to be made available in the near future. The insulation is obtainable for all Class H insulated form wound coils and for Class A and Class B windings operating under certain service conditions. Prices are said to be generally on the level of previous insulations.



Stator for 2500-hp., 2300-volt, 3580-rpm. squirrel-cage induction motor wound with Silco-Flex

Enters Polyethylene Field

Phillips Chemical Co., wholly owned subsidiary of Phillips Petroleum Co., will immediately begin construction of a large plant to produce Marlex, its new polyethylene, near Pasadena, Tex., and a 145-million pound per year ethylene plant at the Phillips refinery near Sweeny, Tex.

The first unit of the Marlex plant will be rushed to completion as soon as possible because of the huge demand for this new line of improved polyethylene, and additional lines will be completed at intervals of several months thereafter. Marlex polyethylene is made by a Phillips developed low-pressure catalytic process announced a year ago.

Phillips officials stated that the demand for Marlex appears so great that the Marlex process will be licensed to others in the near future.

Tires for Speed Classic

Two completely new series of its tires will be grinding over the 500-mile course at this year's Memorial Day racing classic at Indianapolis, Ind., The Firestone Tire & Rubber Co., Akron, O., reveals. Design changes over tires previously used in the automotive marathon include a slightly narrower tread for improved maneuverability and a thicker tread for increased wear and safety.

According to the company, all cars will use the new 7:60 x 16 front tires, an increase in size from the 7:10 x 16 used in 1954, except the Novi, which will be equipped with 8:00 x 20's. The new fronts will have two circumferential grooves instead of the three previously employed; these tires are designed to give better holding characteristics in operation with the new rear tires. The ribs are also engineered to provide quick visual tread depth of tires during the race, Firestone says.

Koroseal Belt Cuts Costs

A Koroseal conveyor belt in a spray booth at the trim plant of Ford Motor Co., Detroit, Mich., is credited with a 30% decrease in the overall maintenance operation needed on the belt used for conveying trim panels, according to The B. F. Goodrich Co., Industrial Products Division, Akron, O., maker of the belt.

The belt carries trim panels through the booth where they are sprayed with a rubber latex to bind the parts together. Formerly, the build-up of the rubber latex on conventional belts was so rapid that it was necessary to shut down the unit every four hours to install muslin protective belt sleeves, a 35-minute operation, Goodrich says.

Koroseal proved advantageous because of its smooth, non-porous surface which permitted rubber latex to be peeled off easily at the end of each eight-hour shift. The belts, first introduced in 1954, are also tough and flexible and resist abrasion, oils, grease, most acids, and flaking or checking, according to Goodrich.

Leasing Tread Matrices

To assist its dealers in increasing their sales and profits in the expanding field of tire retreading, The Firestone Tire & Rubber Co., Akron, O., has instituted a new policy of leasing its design matrices to its franchised dealers, according to J. W. Hodgson, manager of treading and repair material sales.

The dealer first pays a small advance rental on the matrices, then pays a monthly rental for the first two years of use, after which a low annual rental is required, Mr. Hodgson says. This policy enables the dealer to acquire up-to-date treads without tying up working capital.

Foamcoat Distributor

Collins & Aikman Corp., New York, N. Y., has named Pinebrook Fabrics, Inc., New York, distributor to the brassiere and corset industry for its foam rubber-backed fabrics known as Candalon Foamcoat. The Pinebrook firm was recently formed to supply manufacturers of brassieres, corsets, and bathing suits with various types of fabrics which had been coated with foam rubber.

Collins & Aikman also plans to make foam rubber fabrics for the shoe industry and other fields, according to William F. Flower, general sales manager of the foam rubber fabrics division.

News about People

B. R. Wendrow

B. R. Wendrow has been named chief chemist, development department, for U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

Robert L. Fosburg has been named senior sales representative in the New England area for Wyandotte Chemicals Corp., Michigan Alkali Division, Wyandotte, Mich.

C. C. Fuller has been named vice president in association with the sales management staff of Foxboro Co., Foxboro, Mass. Also advanced were **H. O. Ehrisman** to general sales manager, and **J. J. Burnett** to field sales manager. **C. E. Sullivan,** a vice president, has retired from the position of general sales manager, but will continue to serve in a consulting capacity.

Martin G. Levens has been named assistant district sales manager for the Philadelphia, Pa., office of Columbia-Southern Chemical Corp., Pittsburgh, Pa. **R. D. Hammond** succeeds him as salesman at the Cleveland, O., office.

Wm. Howlett Gardner has been transferred from the new products division of National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y., to the company's chemical sales department where he will serve dually as writer of technical literature and technical sales representative.

I. Bergsteinsson has been named senior market research and development engineer for Brea Chemicals, Inc., Los Angeles, Calif.

Robert E. Cunningham has been appointed to the polyester synthetic rubber section, research division, of The Goodyear Tire & Rubber Co., Akron, O.

Mel Anderson has been elected secretary-treasurer and a director of Gross Mfg. Co., Inc., Monrovia, Calif., and will continue his functions as general manager.

J. Edward Martin has become vice president in charge of plant operations for The Williams-Bowman Rubber Co., Cicero, Ill.

William Pahl has become a member of the staff of American Mineral Spirits Co., South Gate, Calif., and will cover the San Francisco Bay area.

Richard M. Brown has joined the sales staff of S. S. Skelton Co., Cleveland, O.

Frank H. Smart has joined Harchem Division, Wallace & Tiernan, Inc., Belleville, N. J., as assistant to the director of sales, with special reference to plasticizers and sebacic acid.

Frank H. Smart

R. S. Abrams has been appointed plant manager of the new Long Reach, W. Va., silicones plant of Linde Air Products Co., division of Union Carbide & Carbon Corp., New York, N. Y. Also reassigned to the new plant from the firm's Tonawanda, N. Y., facilities are **J. J. Doub,** as superintendent of production; **Herbert Wickman,** as superintendent of administration; **H. C. Givens,** as chief chemist; **G. M. Fowles,** as plant engineer; **J. W. Ramsey,** as office supervisor; **J. P. Daneman,** as purchasing agent; and **J. J. Hock,** as industrial relations representative.

James W. Fullerton has been named field engineer in the St. Louis, Mo., area for Republic Rubber Division, Lee Rubber & Tire Corp., Youngstown, O., and **Robert A. Hopkins** has been appointed field engineer in the Kansas City, Mo., area.

R. C. Boltz and **G. E. Kuehn** have been named district sales managers of the Newark and Buffalo districts, respectively, for Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. **G. S. Cooper, J. W. Locher,** and **B. W. Hurley** have been transferred to the New York, Pittsburgh, and Indianapolis sales districts, respectively.

Ralph Winslow, vice president of Koppers Co., Inc., Pittsburgh, Pa., has been named to direct a newly formed company-wide marketing department. **Cooke Bausman, Jr.,** has become assistant to the general manager of Koppers' chemical division, and **George W. Naylor** has been appointed the division's international department manager. **Harry P. Neher** replaces Mr. Naylor as assistant sales manager of the tar products division.

J. E. Miller

Robert C. Sutter has been appointed assistant director of engineering for Diamond Alkali Co., Cleveland, O. His former position as chief group engineer of the firm's central engineering department's staff section at Painesville, O., has been assumed by **Edward J. Loeffler, Jr.**

Joseph F. Hutchinson, assistant general manager of the metal products division of The Goodyear Tire & Rubber Co., Akron, O., has been advanced to manager of the firm's automotive engineering division, replacing **J. C. Tuttle,** who has been named consulting engineer for the automotive engineering division. **Gene C. Huffman** has been elevated to the position of superintendent of the metal products division.

Herbert R. Buck has been transferred from the staff training department of The Goodyear Tire & Rubber Co., Akron, O., to the process engineering section of its research division. Also appointed to the research division, analytical laboratory, was **Janet M. Cole.**

Harold Von Thaden, vice president and general manager of the International Division of Hewitt-Robins, Inc., Stamford, Conn., is on a three-month tour of the firm's subsidiary and affiliated companies in England, Italy, South Africa, Holland, and France.

Norman Estlingy, a recent graduate of the Rubber Technology course sponsored by The Los Angeles Rubber Group, Inc., at the University of Southern California, has joined the technical department of Fullerton Mfg. Co., Los Angeles, Calif.

Henry N. Marsh, smokeless powder consultant to the explosives department of Hercules Powder Co., Wilmington, Del., and the firm's adviser on civilian and military matters, has been granted a year's leave of absence to serve as Deputy Assistant Secretary of the Army in logistics and research and development.

S. A. Swensrud, chairman of the board of Gulf Oil Corp., has been elected chairman of the board of Goodrich-Gulf Chemicals, Inc., Cleveland, O., recent purchasers of the government-owned synthetic rubber manufacturing facilities at Port Neches, Tex. **William I. Burt** has been reelected president. **P. W. Cornell,** a company director since 1953, has been elected vice president in charge of operations, engineering, and development. Named general sales manager was **J. E. Miller,** formerly manager of The B. F. Goodrich Chemical Co.'s copolymer plant at Port Neches. The Goodrich-Gulf board now consists of Swensrud, Burt, and Cornell, in addition to **L. O. Crockett, John R. Hoover, W. L. Naylor, W. S. Richardson,** and **Frank K. Schoenfeld.**

The Brookner Studio

P. W. Cornell

John R. L. Johnson, Jr., director of the legal department and on the board of directors of Hercules Powder Co., Wilmington, Del., has been elected a member of the finance committee. Reelected to the finance committee were **Edward B. Morrow,** vice president and committee chairman; **Albert E. Forster,** president; and **John E. Goodman,** treasurer.

J. Frank Taylor has been appointed Midwest district manager for Federal Color Laboratories, Inc., Cincinnati, O., with offices in Northlake, Ill., a Chicago suburb. A former chairman of the Chicago Rubber Group, he was once associated with Commercial Solvents Corp. and Chicago Copper & Chemical Co. in executive sales capacities.

Ewald R. Olson and **Joseph A. Farnell** have been appointed truck and bus tire representatives for Dunlop Tire & Rubber Corp., Buffalo, N. Y., in the New York, N. Y., and Atlanta, Ga., sales areas, respectively.

George K. Guinzburg, vice president and a director of I. B. Kleinert Rubber Co., New York, N. Y., is in Europe on a two-month business and pleasure jaunt.

Lloyd C. Adam has been appointed sales manager in charge of the rubber and plastics machinery division of Erie Engine & Mfg. Co., Erie, Pa.

Lloyd C. Adam

George V. Dupont has been appointed manager of manufacturing operations for Diamond Black Leaf Co., a joint venture of Diamond Alkali Co. and Virginia-Carolina Chemical Corp.

Philip B. Keller has been appointed vice president in charge of engineering at Stillman Rubber Co., Culver City, Calif.

G. D. Hitler has been appointed manager of dealer sales for The Firestone Tire & Rubber Co., Akron, O.

Gilbert F. Stenger has been named manager of battery marketing for the B. F. Goodrich Co. Tire & Equipment Division, succeeding **E. R. Bell,** a 30-year veteran of battery sales, who has retired.

James R. Cowan has been elected chairman of the board of Georgia Marble Co., Atlanta, Ga. Elected also were **John W. Dent,** president; and **Frank C. Owens** and **Margaret Tate Benton,** directors.

R. S. Wilson, vice president in charge of sales for The Goodyear Tire & Rubber Co., Akron, O., has been elected an honorary member of Beta Gamma Sigma, national honorary society of commerce and business administration.

T. R. Miller has been appointed director of the South Charleston plant laboratories of Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y.

Willard C. Gulick, president of International B. F. Goodrich Co., Akron, O., has been reelected to the board of directors of the International Road Federation.

James W. Maples

O. H. McCollum and **James M. McCurdy** have been transferred to the technical sales forces of the Chicago and Akron district offices, respectively, of E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del.

George W. Lewis, Jr., and **Howard S. Ring,** both research chemists, have joined the Detroit, Mich., laboratories of Climax Molybdenum Co., New York, N. Y.

Phil Grimes has been elected vice president of California Testing Laboratories, Los Angeles, Calif.

Julius C. Hydrick has been named works manager of Quaker Rubber Corp., division of H. K. Porter Co., Inc., Philadelphia, Pa.

Lynn W. Baker, assistant counsel for The Goodyear Tire & Rubber Co., Akron, O., has retired after 37 years of service.

James W. Maples has been appointed director of manufacturing for all rubber manufacturing plants in the United States and Canada of The Firestone Tire & Rubber Co., Akron, O. He joined the company in 1926 and served as a salesman before entering the production division. In 1934 he was named factory manager of the firm's British plant, a post he held for ten years. He subsequently became production manager for Firestone's tire plants in the United States. **Herbert H. Wiedenmann,** associated with the company since 1928, now assumes this latter position.

Herbert H. Wiedenmann

Cyril P. Gamber has been named controller of Quaker Rubber Corp., division of H. K. Porter Co., Inc., Philadelphia, Pa.

Donald Berg has joined West American Sales Co., Los Angeles, Calif., representative for West American Rubber Co. and Vulcan Rubber Co., as a sales engineer.

News Briefs

The B. F. Goodrich Co. Industrial Products Division, Akron, O., has introduced a new rubber V-belt for motorized home appliances that is said to absorb 24% more vibration than belts presently rated as low vibration belts. Trade name is Vibrasorb.

Dow Corning Corp., Midland, Mich., has named J. F. Dellaria special coordinator between its silicone development laboratories and those of the aircraft industry.

United States Rubber Co., New York, N. Y., is distributing free a 24-minute, 16-mm. black-and-white sound film entitled "Memo to Mars" which dramatizes the need of better highways and parking facilities.

Armstrong Cork Co., Lancaster, Pa., will market part of the output of Fiberglas industrial insulations of Owens-Corning Fiberglas Corp., Toledo, O., under the trade name Armaglas.

Thiokol Chemical Corp., Trenton, N. J., has granted a total of $5,000 to Drexel Institute of Technology, Philadelphia, Pa.; Brooklyn Polytechnic Institute, Brooklyn, N. Y.; and Rider College, Trenton, N. J., for the encouragement of advanced training for scientific and business personnel.

Witco Chemical Co. has moved its sales and executive offices to the Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.

Westinghouse Air Brake Co., air brake division, Wilmerding, Pa., has named DeWitt L. Shelly manager of its new special products group which will specialize in manufacture, assembly, and test of general industrial apparatus and components, including pressure tanks, precision gears, electronic chassis, molded rubber and plastics, and grey iron, brass, and aluminum castings.

Wild & Stevens, Inc., Newton Upper Falls, Mass., has purchased Ellis Allen Co., Woburn, Mass., manufacturer of industrial rubber goods.

Carlisle Chemical Works, Inc., Reading, O., has purchased Advance Solvents & Chemical Corp., New York, N. Y., manufacturer of paint and printing driers, stabilizers, plasticizers, and a variety of specialty compounds. Advance has several subsidiary companies, including a Canadian branch and an export subsidiary; its manufacturing facilities are in Jersey City, N. J.

The General Tire & Rubber Co., textileather division, Toledo, O., and **United States Rubber Co.,** coated fabrics department, Mishawaka, Ind., have engaged exhibit space at the forthcoming NAFM Supply, Equipment & Fabric Fair, sponsored by the National Association of Furniture Manufacturers, to be held at the Conrad Hilton Hotel, Chicago, Ill., August 28 to September 1.

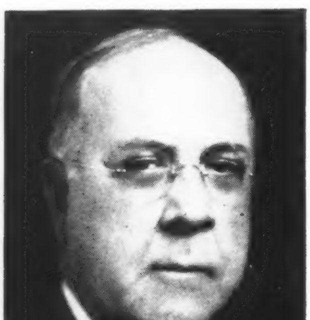
Industrial Equipment Co., Joplin, Mo., has been named distributor for its O-rings by Parker Appliance Co., Cleveland, O.

The B. F. Goodrich Co., Akron, O., has been granted a patent covering an inflatable rubber strip that seals bubble-type cockpit canopies of high-altitude military airplanes. The strip is also applicable as a weather seal between fuselages and detachable cargo pods of transport aircraft and for water seals in amphibious vehicles.

The Goodyear Tire & Rubber Co., Akron, O., has developed a long-lasting platen gasket for military and commercial aircraft fuel and lubricating systems which is said to increase the safety and efficiency of such systems.

New Bedford Defense Products, New Bedford, Mass., a division of the Firestone Tire & Rubber Co., has been awarded a $2,500,000 contract by the Boston Ordnance Procurement Agency in New England, for the manufacture of 155-mm. artillery shells.

Obituaries



K. C. Gardner

K. C. Gardner

K. C. Gardner, chairman of the board and chief executive officer of United Engineering & Foundry Co., Pittsburgh, Pa., died April 15 in a Sewickley, Pa., hospital at the age of 78.

He attended the University School and Case School of Applied Science, Cleveland, O., and upon his graduation in 1899 joined Lloyd Booth Co., Youngstown, O., a predecessor of United Engineering & Foundry Co. His subsequent rise in the United organization began with his appointment as machinery sales engineer in 1901 and included his election to the board of directors in 1911, advancement to general sales manager in 1929, president and general manager in 1943, and chairman of the board of directors in 1952.

At the time of his death he held directorships in the Peoples First National Bank & Trust Co., Woodings Verona Tool Works, Pittsburgh Testing Laboratory, Greater Pittsburgh Parks Association, Adamson United Co., and Stedman Foundry & Machine Co.

He was a member of the American Iron & Steel Institute, the Iron & Steel Institute of Britain, American Society of Mechanical Engineers, Advisory Board of Pittsburgh Ordnance District, the U. S. Chamber of Commerce, Newcomen Society, and the Duquesne, Allegheny County, Edgeworth, and Youngstown clubs.

Surviving Mr. Gardner are his wife, three daughters, two sons, 16 grandchildren, and four great grandchildren.

Gladding Price

Gladding Price

Gladding Price, New England representative of R. T. Vanderbilt Co., died March 29 at his home in East Greenwich, R. I., from a coronary condition. He had been in ill health for some time.

The oldest member of the Vanderbilt sales organization in point of service, Mr. Price first became associated with the company in July, 1920, after having served with United States Rubber Co., The Goodyear Tire & Rubber Co., and Davol Rubber Co.

He held memberships in the American Chemical Society, the Sons of the American Revolution, and the Quinnipiack Club.

He was born in Providence, R. I., on May 15, 1897, and educated in the local public schools.

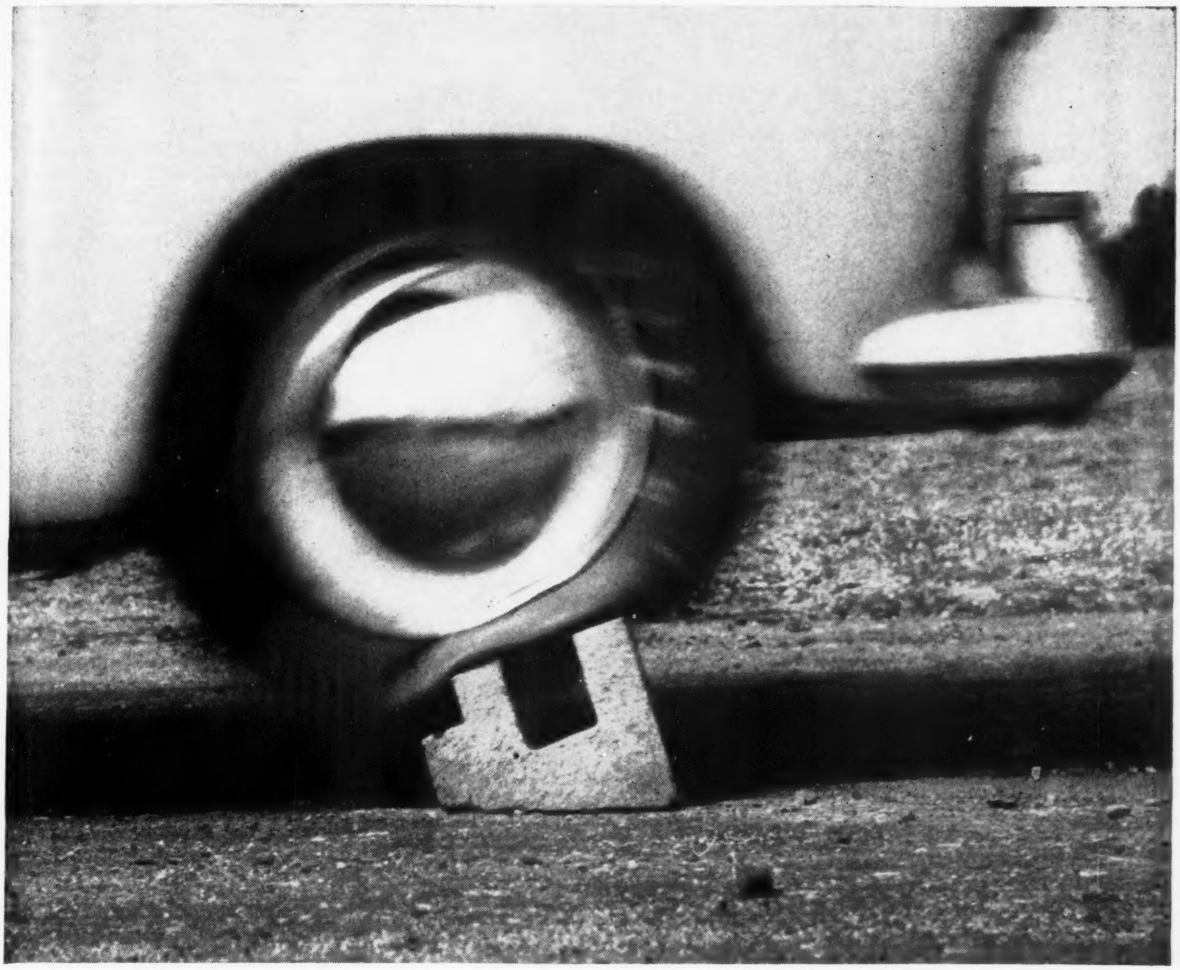
Funeral services and cremation took place in East Greenwich.

He is survived by his sister.

Edward C. Schwab

Edward C. Schwab, head of the rubber purchasing division of United States Rubber Co., New York, N. Y., died March 31 of an embolism following an operation in a New York, N. Y., hospital.

Joining U. S. Rubber in 1917 as a bookkeeper in the auditing department, Mr. Schwab never left the company's employ.



He became a vice president of General Rubber Co., a subsidiary, in 1929, a crude rubber buyer for the parent company in 1934, and chief buyer in 1943.

He was his company's representative to The Rubber Manufacturers Association, Inc., since 1935, and served in numerous advisory positions on rubber purchasing with the government.

The deceased was born in Utica, N. Y., on August 19, 1893.

Requiem Mass was said at St. Vincent Ferrer Church, New York, on April 2, and burial took place in Gate of Heaven Cemetery, Pleasantville, N. Y.

Surviving Mr. Schwab are his wife and three sisters.

William Shaw

William Shaw, for more than 30 years head of the cable machinery engineering division of David Bridge & Co., Ltd., Castleton, England, died March 25 after a short illness.

Mr. Shaw was born in Halifax, Yorkshire, 74 years ago. Before joining David Bridge & Co., he had served in various executive engineering and production capacities with Macintosh Cable Co. and W. T. Glover & Co., Ltd.

Funeral services and burial took place at Brooklands Cemetery, Sale, Cheshire, on March 29.

He is survived by a daughter.

Financial

American Cyanamid Co., New York, N. Y., and subsidiaries. Initial quarter, 1955: net profit, $9,453,616, equal to $1.02 a common share, contrasted with $7,603,-476, or 87¢ a share, in the corresponding quarter last year; net sales, $111,643,065, against $98,205,113.

Anaconda Wire & Cable Co., New York, N. Y. For 1954: net income, $4,700,213, equal to $5.57 a share, compared with $6,015,386, or $7.13 a share, the year before; sales, $108,982,644, against $131,-885,120.

Belden Mfg. Co., Chicago, Ill. For 1954: net earnings, $1,085,361, equal to $3.39 a share, compared with $1,386,952, or $4.33 a share, in 1953.

Borg-Warner Corp., Chicago, Ill., and subsidiaries. First three months, 1955: net profit, $9,151,118, equal to $1.23 a common share, contrasted with $5,001,506, or 67¢ a share, in the 1954 months; net sales, $136,656,079, against $97,807,117.

Crown Cork & Seal Co., Inc., Baltimore, Md., and domestic subsidiaries. Year ended December 31, 1954: net profit, $1,415,-695, equal to 72¢ each on 1,207,790 common shares, against $1,531,823, or 81¢ a share, the year before; net sales, $111,436,-991, against $106,785,708; income taxes, $1,196,267, against $1,581,323.

Circle Wire & Cable Corp., Maspeth, L. I., N. Y. For 1954: net earnings, $1,-307,141, equal to $1.74 a common share, compared with $1,814,823, or $2.42 a share, in 1953; sales, $16,586,276, against $22,145,892; current assets, $9,857,000, current liabilities, $2,686,296, against $11,-507,715 and $3,855,282, respectively, on December 31, 1953.

Boston Woven Hose & Rubber Co., Cambridge, Mass. Six months ended February 28, 1955: net earnings, $116,496, equal to 27¢ each on 344,000 common shares, contrasted with net loss of $278,-376 in the 1954 period; net sales, $7,589,-233, against $7,138,501.

Detroit Gasket & Mfg. Co., Detroit, Mich. For 1954: net profit, $941,664, equal to $1.81 a common share, compared with $1,195,420, or $2.28 a share, the year before.

Diamond Alkali Co., Cleveland, O. March quarter, 1955: net income, $1,632,-905, equal to 66¢ each on 2,268,143 common shares, compared with $1,365,116, or 54¢ each on 2,264,073 shares, in the '54 period; net sales, $24,471,044, against $22,-184,991.

Dow Chemical Co., Midland, Mich., and subsidiaries. Nine months ended February 28, 1955: net profit, $26,931,398, equal to $1.17 each on 22,651,215 common shares, against $24,184,963, or $1.03 each on 22,651,011 shares, a year earlier; net sales, $336,118,096, against $312,080,993.

Dunlop Canada, Ltd., Toronto, Ont. For 1954: net profit, $115,134, contrasted with $299,265 the year before; income taxes, $85,100, against $217,000; current assets, $10,342,064, current liabilities, $5,306,317, against $10,035,778 and $2,791,181, respectively, on December 31, 1953.

Flintkote Co., New York, N. Y., and subsidiaries. Twelve weeks ended March 26, 1955: net income, $600,127, equal to 41¢ each on 1,296,160 common shares, against $646,110, or 45¢ each on 1,260,435 shares, in the 1954 weeks; net sales, $19,-427,245, against $18,241,614.

Dayton Rubber Co., Dayton, O. Five months to March 31, 1955: net profit, $779,565, equal to $1.26 a share, contrasted with $218,387, or 31¢ a share, a year earlier.

General Cable Corp., New York, N. Y. First three months, 1955: net income, $1,382,380, equal to 60¢ each on 2,077,-860 common shares, against $1,280,663, or 58¢ each on 1,933,372 shares, in the corresponding period of 1954.

General Electric Co., Schenectady, N. Y. March quarter, 1955: net income, $50,-569,000, equal to 58¢ a share, against $48,-029,000, or 56¢ a share, in last year's quarter.

General Motors Corp., Detroit, Mich. January 1-March 31, 1955: net earnings, $309,000,000, equal to $3.43 a common share, contrasted with $189,167,333, or $2.13 a share, in the like period last year; net sales, $3,101,000,000, against $2,410,-000,000.

The General Tire & Rubber Co., Akron, O. Quarter ended February 28, 1955: net income, $2,236,310, equal to $1.62 each on 1,243,968 common shares, contrasted with $1,851,515, or $1.46 each on 1,208,-062 shares, in the 1954 period; sales, $63,-574,233, against $44,130,274.

The B. F. Goodrich Co., Akron, O. Three months ended March 31, 1955: net profit, $9,840,528, equal to $1.12 each on 8,819,766 common shares, compared with $8,556,458, or $1.02 each on 8,397,164 shares, in the 1954 quarter; net sales, $178,619,306, against $152,023,569.

Hercules Powder Co., Wilmington, Del. Initial quarter, 1955: net profit, $4,254,-734, equal to $1.54 each on 2,690,336 common shares, against $3,362,801, or $1.21 each on 2,684,508 shares, in the like period last year; net sales, $53,130,708, against $43,564,002.

Johns-Manville Corp., New York, N. Y., and subsidiaries. First quarter, 1955: net income, $2,730,699, equal to 86¢ each on 3,184,237 common shares, against $2,592,-406, or 82¢ each on 3,172,328 shares, a year earlier; net sales, $56,269,622, against $51,913,065.

I. B. Kleinert Rubber Co., New York, N. Y. Year ended December 31, 1954: net earnings, $434,562, equal to $2.88 each on 151,096 capital shares, against $367,865, or $2.39 each on 154,121 shares, in the preceding year; sales, $10,-693,000, against $10,207,000.

National Lead Co., New York, N. Y. Quarter ended March 31, 1955: net income, $10,049,082, equal to 84¢ a common share, compared with $8,067,827, or 67¢ a share, in last year's quarter; sales, $119,-407,707, against $100,656,717.

(Continued on page 266)

SPECIFY EMERY PLASTOLEIN 9720

...and give your plastics "lasting power"—greater sales appeal!

Where your plastic must stand up to the constant wear of boys' shoes on bus seats... or the cold, rain and sun on auto upholstery... or the eroding elements of the weather on lawn furniture... Emery Plastolein 9720 will give it outstanding durability, weatherability, resistance to wear, and "wipe-off." And since it is the lowest priced polymeric plasticizer available, you get these benefits at lowest cost.

A polyester type compound, this unusually stable plasticizer was compounded specifically to provide durability in heavy-gauge vinyl sheeting. It provides unusually low volatility, high resistance to oil and water extraction, excellent stability to heat and light, and high resistance to migration. Moreover, it is easier to handle, more readily pumped and shipped in bulk than other common polymeric plasticizers.

These characteristics can be important to you. That's why it will pay you to evaluate Plastolein 9720 in your formulation.

Write today to Dept. I-5 for descriptive booklet or for evaluation samples.

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Fatty Acids & Derivatives
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News from Abroad

Malaya

Will Smallholders Replant?

The question of smallholder replanting continues more or less in the limelight. The public has hardly had time to read and digest the newest announcement of the Chief Replanting Officer, A. C. Smith, that applications from smallholders have exceeded the target of 60,000 acres to be replanted in 1955, than it is pulled up sharply by the statement of Tan Sieuw Sin, publicity chief of the Malayan Chinese Association, that smallholders are losing interest in the replanting scheme because they are losing money under it, and by his suggestion that smallholders therefore should be allowed to open up new land with funds from the replanting cess.

The idea is not altogether new, and no doubt some in government circles would favor it if it seemed practicable. But what, if any, consideration the government will actually give it, remains to be seen.

30-Year Trees Not Too Old

Replanting, as well as the emergency situation and, of course, the outlook, figures prominently in some recent annual reports of Malayan rubber companies.

J. K. Swaine, chairman of the Padang Senang Rubber Co., speaking at the company's annual meeting in London, attacked the Mudie Mission's conclusion that rubber trees ceased to be economic in their thirtieth year and should be replanted. The recommendation, he is quoted as saying, was based on questionable figures and benefited the bad planter while penalizing the good planter. Trees that had not been tapped too young and too hard should be little past their prime in their thirtieth year. On his company's estate, 56-year-old trees promised to continue being fine economic tapping propositions for at least 10 years more.

Mr. Swaine seems to have brought up again the old questions: At what age does *Hevea* cease to be economic and, what makes a well-run profitable estate?

The Outlook

If Sir John Hay, chairman of Linggi Plantations, Ltd., in his address at the company's fifty-ninth annual general meeting, is critical of the Mudie report, it is for a somewhat different reason, as is clear from his remarks (naming no names):

"Since replanting is at times referred to as if it were a recent official discovery which can only be efficiently carried out if put under bureaucratic control, perhaps I may be permitted to mention here that more than 30 years ago we started experimental replanting, and some of our estates have reached the stage of replanting to the second generation. Replanting is not an operation to be carried out by a rule-of-thumb method designed by some official who has a nodding acquaintance with a rubber tree."

At present Linggi has 85% of its total planted area under high-yielding stock; there are still almost 2,000 acres of seedling rubber, of which 800 acres are to be replanted in the next three years; on the remainder, it is proposed to substitute tea for rubber.

Turning to prices, Sir John outlined the causes of the unexpected rise, adding that agreeable though the unwonted prosperity it brought might be, producers and consumers would prefer a stable price at a reasonable profit. His forecast for 1955, presented with suitable reservations as to the vagaries of the rubber market, is that production and consumption of natural rubber will be in close balance, with production at 1,850,000 tons and consumption at 1,825,000 tons, representing in each case an increase of 75,000 tons over 1954 figures. Malayan output is placed at around 600,000 tons; Indonesia and other countries are expected to contribute the major part of the increase.

Despite some disorganization, Sir John pointed out, the marginal producer—the smallholder in outlying districts—continues to respond to good prices.

As to consumption, the United States is expected to increase total use of both natural and synthetic, but in view of present prices it seems prudent to expect the ratio to be 44% crude and 56% synthetic. Consumption of natural rubber by Iron Curtain countries can only be guessed at, but an increase of 20,000 tons is looked for, to bring the total for 1955 to 145,000 tons.

Still an Emergency

That the emergency still exists in Malaya is brought out in the report of the Pataling Rubber Estates which states that though, on the whole, security conditions improved slightly last year, terrorism had actually increased on some of the estates and continued to cause uneasiness and to require watchfulness on others. Nevertheless, Pataling was able to replant 940 acres of old rubber in 1954; in the current year it proposes to replant 1,100 acres, and 2,700 acres more are scheduled for replanting in 1956 and 1957. The area replanted with selected material is now 45% of the whole, and by 1957 the unselected rubber—of which a good proportion still produces highly economic yields—will represent less than 40% of the total rubber acreage.

In his speech at the thirty-fifth annual general meeting of the company, the chairman, Sir Eric Miller—like Sir John Hay—expressed himself in favor of more moderate, but stable prices. Referring to the peak reached earlier in 1955 and the subsequent decline in prices, he added that although producers and manufacturers alike would be thankful for a period of prices around 25d-26d a pound, further movements up or down were inevitable.

One wonders to what extent people here in Malaya agree with the conclusion arrived at by a Special Correspondent of the London Times, lately in Malaya, that the emergency has brought benefits to Malaya as well as calamities.

In the March 3 and March 11, 1955, issues of this paper, the correspondent sets forth what he found to be the four major effects of the emergency in Malaya: the creation of some 500 new Chinese villages —mostly prosperous, stable, contented communities now containing half a million ex-squatters from the jungle fringes; the gradual entry of the Chinese community as a whole into a share of the responsibilities of government; the integration of police, army, and civilians of all population groups here; and the changing conditions of the 50,000-60,000 aborigines.

These, he finds, constitute four aspects of an administration which has developed closer contact with the people than any before, and he foresees that when Malaya eventually has the civil service she needs for self-government, "It will be rooted in a relationship with every class of the community that will give it an unparalleled opportunity for good government."

Changeover No Cause for Joy

A fact to be noted is the change in the estimate of producers as to the probable price of synthetic rubber once the American factories are privately owned. Until recently the time when synthetic production passed from the government to private hands was looked forward to eagerly, in the expectation that, for a time at least, production costs under the new conditions would be higher, and natural rubber would therefore have a better chance. Now, it appears, more and more rubber men are beginning to have their doubts and are recommending caution.

At the annual meeting of Tanjong Malim Rubber Co., the chairman, H. H. Facer, said in this regard that it was very difficult to say whether the changeover would result in a decrease or increase in the cost of producing, and hence the price of, synthetic, and that a prudent course was clearly indicated, for if the new ownership led to lower synthetic prices, then natural rubber would have to do all in its power to meet the challenge.

This company is another of those which have been suffering from terroristic acts,

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VORLD

Enjay now foremost butyl rubber supplier

90,000 tons yearly production of Enjay Butyl, now available from its originators, will go into varied industrial products

Enjay Company, Inc., a pioneer and leading supplier of petroleum chemicals, will market Butyl and supply advisory service in its applications.

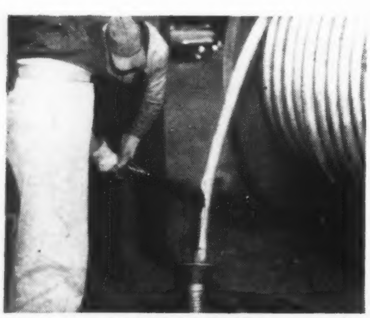
The low price and high-level performance of Enjay Butyl allow it to replace natural and other rubbers now used in industry. Enjay Butyl is the rubber that combines high resistance to aging . . . abrasion . . . tear . . . chipping or cracking . . . ozone or corona . . . chemicals and gases . . . heat . . . cold . . . sunlight . . . and moisture.

The new Enjay Laboratories, located at Linden, New Jersey, are equipped to provide expert technical assistance in compounding and adapting Enjay Butyl to individual uses and requirements.

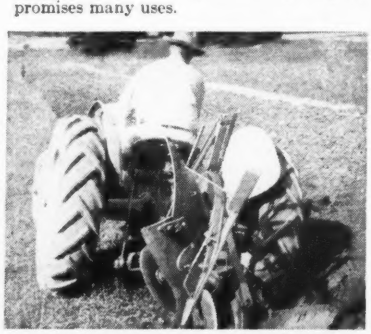
Distinctive properties and low price give Enjay Butyl wide industrial application

Inner tubes are made of BUTYL because BUTYL holds air ten times better than natural rubber. Its impermeability to gases promises many uses.

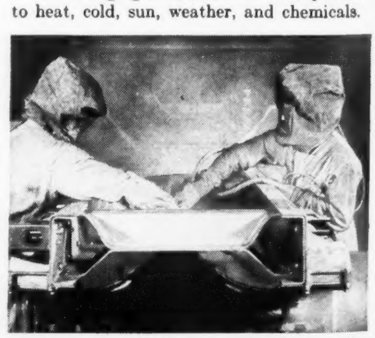
1955 cars use Butyl for dozens of rubber parts, because BUTYL has super-durable resistance to aging or deterioration on exposure to heat, cold, sun, weather, and chemicals.



High voltage electrical cables are made with BUTYL because BUTYL offers superior corona and ozone resistance, combined with excellent heat, cold, and abrasion resistance.



Tractor tires are made with BUTYL because BUTYL gives low tread wear and high resistance to weather, cracking, cutting, and chipping.



Protective clothing, tank linings, belt covers, hoses, and other equipment in contact with chemicals use BUTYL because of its exceptional resistance to chemicals.


GIANT TOWERS at a plant producing Enjay Butyl reflect the massive achievement of manufacturing rubber from petroleum.
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BUTYL

and the fact that it is behindhand in replanting is laid largely to circumstances arising from the emergency which, Mr. Facer said, is by no means dead in Malaya or in the Tanjong Malim district.

Technically Classified Rubber

Malayan producers through the Rubber Research Institute will at the same time urge greater use of technically classified rubber, at the above conference. According to Mr. Holiday, there is a moderate demand from some smaller consumers for T.C.R., but the big manufacturers are not particularly interested, and apparently the case for T.C.R. will be presented in New York with a veiw to obtaining their support, without which the market for these grades could not develop as desired.

The production of Technically Classified Rubber has been increasing steadily in Malaya. Latest figures issued by the Secretariat of the International Rubber Study Group put Malayan output in 1954 at 38,067 long tons, against 27,837 long tons in 1953 and 17,102 long tons in 1952. At the same time, production in Viet-Nam and Cambodia, where the idea for T.C.R. originated—after almost a 100% increase in 1953, showed a decrease in 1954; while Indonesia is now making up for her late start. The development of T.C.R. in the three centers mentioned is shown in the following table (in long tons):

	1954	1953	1952
Malaya	38,067	27,837	17,102
Viet-Nam and Cambodia	12,204	14,671	7,443
Indonesia	10,319	5,752	50
Total	60,590	48,260	24,595

Maintaining Malayan Rubber Standards

The importance of maintaining and improving the technical quality of Malayan rubber and the threat to these qualities that skim latex rubber constituted, were particularly emphasized by E. G. Holiday, chairman of the Singapore Chamber of Commerce Rubber Association, at the annual meeting. Skim latex rubber is the residue from the concentration of liquid latices; by itself it can be used in the manufacture of goods which require no high tensile strength. Packed with the usual grades of rubber, it has a badly deteriorating effect on the bales and thus could cause great damage to the Malayan rubber industry.

The Association has for some time been urging that the disposal of this rubber be under some form of control; there have been suggestions that the control be on an international basis; indeed the Malayan Rubber Export Registration Board is to bring to the attention of the May International Rubber Quality and Packing Conference in New York, the question of drawing up world arrangements for the disposal of this product and evolving a system for easily identifying it to prevent its being mixed with better grades of rubber in shipment.

Meanwhile Mr. Holiday recommended that efforts be made in Malaya to find regular markets for this by-product.

Rubber Industry Notes

With the average price for rubber during the first quarter of 1955 over 90 Straits cents per pound, about 320,000 plantation workers in Malaya will receive wage increase during the second quarter which—including cost of living allowance—will bring the wage rate to $3.15 (Straits) for contract tappers, $2.70 for check-roll tappers, and $2.20 for field workers. This wage increase is the second this year, made possible by the better prices, and the three categories of workers will be getting respectively 45, 30, and 15 cents more daily than in 1954.

If the price of rubber remains firm around 90 cents a pound, the Federation Government Treasury will net about $98,000,000 in revenue from Malayan rubber production during 1955, the Financial Secretary, E. Himsworth, revealed last March. This would represent a windfall of $50,000,000, since the estimated revenue for 1955—based on a price of 65 cents per pound, had been about $48,000,000.

A total of 1,163,539 long tons of rubber was cleared through the Singapore Chamber of Commerce Rubber Association in 1954; 1,192,066 tons in 1953; 1,068,545 tons in 1952; and 1,253,776 tons in 1951, quantities representing values of some hundreds of millions of Straits dollars annually.

Latin America

Five New Tire Plants in '55

Before long, five new American tire factories will be operating in Latin American countries.

The General Tire & Rubber Co. has already started manufacturing tires and tubes in its recently completed plant in a suburb of Rio de Janeiro, Brazil, making the third which the concern is operating in South America; the other two are in Caracas, Venezuela, and Maipu, Chile.

In March, 1954, United States Rubber Co. began construction on a tire plant at Guacara, in the state of Carabobo, Western Venezuela, L. C. Boos, vice president and general manager in charge of U. S. Rubber International, recently announced. This new factory, being erected on a 50-acre plot, to allow for future expansion, will be especially adapted to the needs of a tropical climate. The unique design provides for a windowless structure having walls which consist of 18-foot high sections set at angles to the building line so that they resemble venetian blinds set on end. Except for a steel mesh on the inside, the spaces between the sections will be left open to admit all the cool air and as little sun glare as possible. Here it is expected to begin production in 1955 with a complete line of U. S. Royal tires and tubes of advanced design for passenger cars and trucks; the new U. S. Royal 8, for passenger cars, and the new Fleetway, for trucks, will be included.

This company already has a modern plant in Caracas, which makes canvas footwear, soles and heels, and miscellaneous products.

It is further learned that U. S. Rubber tires are soon also to be made in Colombia in cooperation with Cia. Croydon del Pacifico, at Cali.

Seiberling Rubber Co. also will have a modern tire plant in Colombia in 1955. Together with Colombian interests, Seiberling some months ago formed Productos de Caucho Villegas, S.A., at Bogota, with which is combined its predecessor, Almacen Villegas. The latter was the foremost manufacturer of rubber flooring in Colombia as well as an important producer of footwear and retread material.

In the presence of a distinguished gathering, headed by the President of Venezuela and the American ambassador, Harvey S. Firestone, chairman of The Firestone Tire & Rubber Co., opened the company's newest South American tire plant, in Valencia, March 26. The new plant—the third Firestone tire factory in South America was built at a cost of $4,500,000; it occupies 100,000 square feet of floor space on a 46-acre tract, employs 350 persons, and has an annual productive capacity of 150,000 tires. It will be run as Compania Anonima Firestone Venezolana.

Firestone's other South American plants are in Buenos Aires, Argentina, and Sao Paulo, Brazil.

Brazil's First-Half 1954 Rubber Use

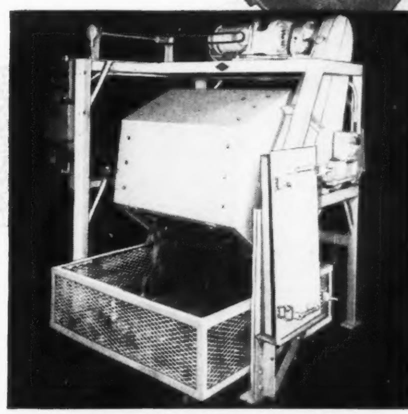
According to official statistics, the Banco de Credito da Amazonia bought up 11,788 metric tons of locally produced natural rubber, excluding latex, during the first half of 1954. During this period consumption, which included unspecified quantities of imported natural rubber, totaled 21,511 tons, of which 17,623 tons were natural rubber; 377 tons, latex; 3,409 tons, reclaim; 88 tons, synthetic rubber; and 14 tons, elastomer latex. Distributed over the various products, consumption (in metric tons) of natural rubber, including latex, was as follows:

Tires for motor vehicles	11,737
Tubes for motor vehicles	812
Tires for bicycles	91
Tubes for bicycles	70
Tire repair material	1,225
Electrical conductors	224
Heels and soles	92
General rubber goods	3,389
	17,640

Altogether Brazilian tire manufacturers produced 906,178 tires for motor vehicles, of which 384,910 were truck and bus tires.

(Continued on page 276)

FLASH-FREE!



The LIQUI-MATIC CO_2 Rubber Tumbler. Time and temperature are automatically controlled. Heavy duty construction. 3" Rubatex insulation throughout. Variable speed drive. Powered by economical 1 H. P. motor.
Adaptable for use with either liquid CO_2 or dry ice.

at lower cost . . . in less time with CO_2 RUBBER TUMBLING

Slick as a whistle! That's how molded rubber products and components come from a CO_2 tumbling barrel. Under this *modern* deflashing method rind and flashing cease to be a problem.

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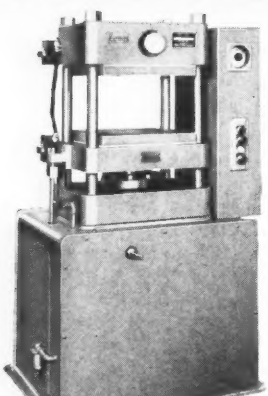


NEW EQUIPMENT

Three-roll, 120-degree type of calender

Adamson Inclined Roll Calender

A new, three-roll calender especially adapted for coating work has been announced by Adamson United Co., 730 Carroll St., Akron 4, O. This machine is a 120-degree type in which the top roll is moved 60 degrees from the vertical plane. The tilt thus provided makes the top bank much easier to feed than it is in a conventional, vertical three-roll calender, and considerably reduces the effect of center roll deflection on the work being done in the bottom pass.

The calender is designed so that it may be equipped with a motorized crossed axis device for the offset roll; and conventional screw adjustment or hydraulic cells can be used on the bottom roll for applying pressure in the coating pass.

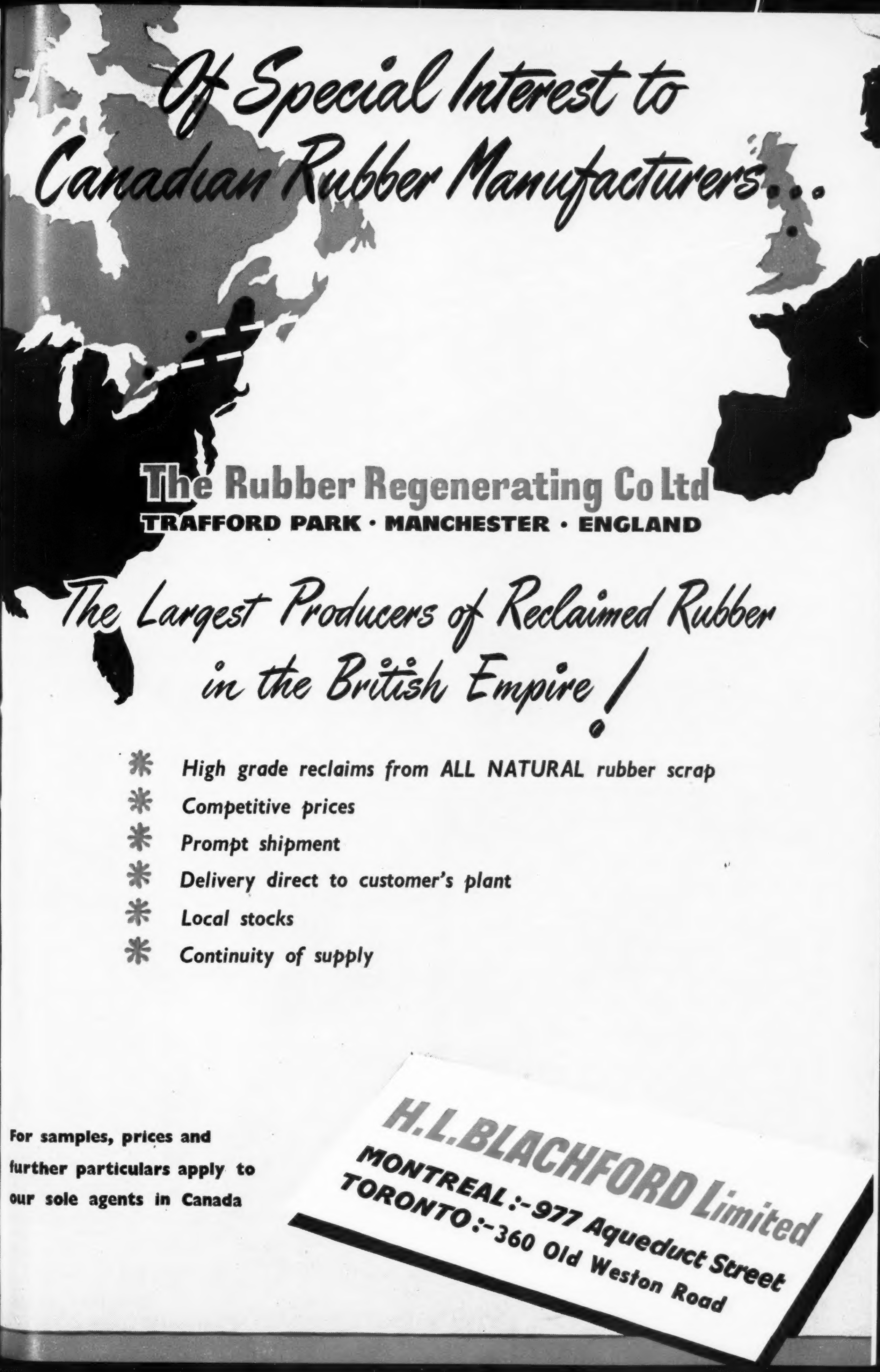
The new calender is available in the 24- by 64-inch size, equipped with either full circle bronze or anti-friction bearings. Lubrication is by an automatic greasing system. Circulating oil lubrication units are available at extra cost.

The speed range of the unit may vary from eight yards per minute for threading up to a maximum of about 75 ypm. The electrical drive has a normal rating of from 125 to 250 hp. and is an adjustable voltage type with infinitely variable stepless control. Friction ratios up to 3:1 are available. Larger ratios can be furnished, using separate special drives for one or more rolls.

This type of calender is particularly adapted for use in tandem operation as a three-roll calender train for double-coating tire fabric, or each calender may be used separately for single-coating operations.

Small Humidity Cabinet

A small mechanical convection temperature-controlled relative humidity cabinet has been placed on the market by Blue M Electric Co., Blue Island, Ill. Called Vapor-Temp, the device is constructed of a 16- by 12-inch, 1.25-cubic foot inverted Pyrex jar set down upon a welded stainless steel cabinet which houses wet and dry bulb controls, heavy-duty motor, corrosion resistant blower, cooling coil, and solenoid valve.


Of Special Interest to
Canadian Rubber Manufacturers...
The Rubber Regenerating Co Ltd
TRAFFORD PARK · MANCHESTER · ENGLAND
The Largest Producers of Reclaimed Rubber
in the British Empire!
High grade reclaims from ALL NATURAL rubber scrap
Competitive prices
Prompt shipment
Delivery direct to customer's plant
Local stocks
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For samples, prices and
further particulars apply to
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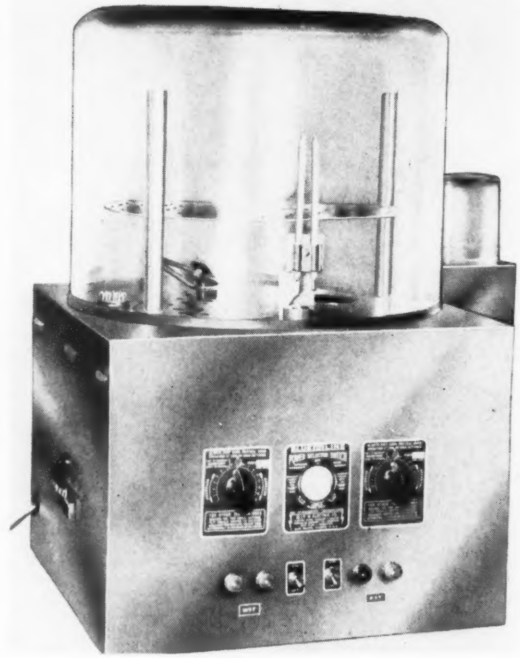
TORONTO :- 360 Old Weston Road

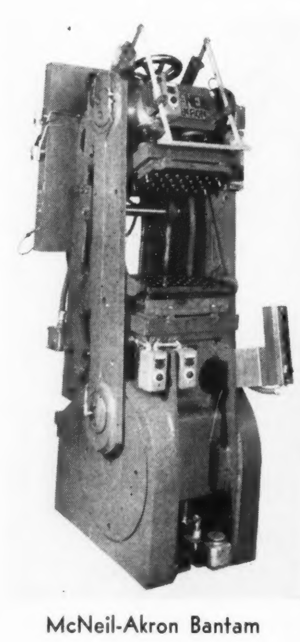


Blue M Electric Co.'s Vapor-Temp

A ½-inch aperture for thermocouple lead-ins or for recording humidity is provided. The wet and dry bulb thermometers, stainless steel water box and wick, and alloy adjustable shelf are standard equipment. Current is 1200 watts, 115 volts, 60-cycle A.C. Either tap or distilled water may be used for cooling.

Controllable relative humidity ranges from 20% to near saturated, depending upon dry bulb temperature. Wet bulb accuracy is within ±2%; dry bulb accuracy is ±1° F. from ambient to 158° F. According to the company, the low cost of the cabinet enables even small laboratories to operate simultaneously a group of these devices under various humidity conditions needed for a single research problem.

Compact Mechanical Goods Press



McNeil-Akron Bantam

A compact and low-cost mechanical rubber goods transfer molding press, said to have been designed for speedy and economical production of small, close-tolerance products, has been introduced by McNeil Machine & Engineering Co., Akron, O.

Called McNeil - Akron Bantam, the new unit is of 10- by 16-inch mold size and handles two-, three-, and four-plate molds automatically.

With its overall dimensions, while closed, at 26½ by 44 by 70 inches, the Bantam requires eight square feet of floor space, an advantageous size in crowded press rooms.

NEW MATERIALS

Neoprene Plasticizer—Drapex 3.2

An epoxy-stearate plasticizer for neoprene stocks that exhibits low volatility and resistance to extraction by oil and is said to impart excellent low-temperature impact strength to compounded neoprene has been placed on the market by Argus Chemical Corp. Called Drapex 3.2, the material is reported to be as efficacious as dioctyl sebacate (DOS) in yielding low-temperature impact strength, but is available at lower cost.

Some physical properties of Drapex 3.2 follow:

Appearance	clear, straw-colored liquid
Specific gravity @ 25° C.	0.89
Odor	faintly fatty
Refractive index @ 25° C.	1.4525
Melting point	—13.5° C.
Boiling range	240° C. @ 2 mm.
Flash point	400° F.
Iodine value (Hanus)	2.5 maximum
Oxirane oxygen	3.2% minimum

Technical Bulletin #4 reporting test data on the plasticizer is available from the company at 633 Court St., Brooklyn 31, N. Y.

Low-Temperature Silastic—S-2048, -6526

Two new Silastic stocks designed specifically for aircraft seals and for low-temperature applications generally have been placed on the market by Dow Corning Corp., Midland, Mich. Called S-2048 and S-6526, both silicone rubbers are white in color and may be fabricated by extrusion, molding, or calendering.

Silastic S-2048, a 60 durometer stock, is highly flame resistant. It can be exposed to 2000° F. for 20 seconds; the stock extinguishes its flame in 30 seconds and shows no signficant change in length, the company says. The rubber maintains its resilience at temperatures as low as —130° F. and has a high mechanical strength.

Silastic S-6526, a 50 durometer stock, shows a high degree of resistance to compression, exhibits flexibility at temperatures as low as —130° F., and requires only a short cure to attain optimum physical properties for low-temperature service.

Important general and preliminary (degree of curing) physical data for both rubbers follow:

	S-2048	S-6526
Specific gravity	1.32	1.24
Molding temperature	240° F.	240° F.
Data after 4 hr./480° F. cure:		
Hardness (Shore)	55	58
Tensile strength	700 psi.	700 psi.
Elongation	180%	200%
Tear strength (Die B, ASTM)	50 lb./in.	——

Monsanto Dibutyl Fumarate

Dibutyl fumarate, an essentially colorless liquid reactive resin and chemical intermediate that can homopolymerize, as well as form copolymers with various monomers under adjusted reaction conditions to produce polymers ranging from brittle resins to soft, internally plasticized polymers, is now available in semi-commercial quantities from Monsanto Chemical Co., St. Louis, Mo.

Copolymers of dibutyl fumarate with vinyl acetate, vinyl chloride, acrylates, and styrene are of special interest in formulat-


WITCO

ing surface coatings, free films, permanently tacky adhesives, fibers, synthetic lubricants, and addition agents for oils. As a chemical intermediate, dibutyl fumarate yields substituted succinates with the addition of halogens, aldehydes, thiols, and similar compounds. Dibutyl fumarate undergoes the Diels-Alder reaction with conjugated dienes.

Typical physical properties are reported as follows:

Refractive index, @ 25° C.	1.4446
Specific gravity, 25°/25° C.	0.9843 (8.2 lbs./gal.)
Acidity	0.05 mg. KOH/g.
Crystallizing point	−18.9° C.
Flash point (Cleveland open cup)	275° F.
Fire point (Cleveland open cup)	300° F.
Boiling points, approximate, mm. Hg.	
760 mm.	285° C.
100 mm.	212° C.
10 mm.	149° C.
1 mm.	103° C.

The material is fully described in the company's technical bulletin, No. ODB-54-18.

Watson-Standard's 16-093 Plastisol

A new chemical-resistant plastisol, supplied as a free-flowing liquid and converted by heat into a flexible, rubber-like coating for application to metal parts, has been introduced by Watson-Standard Co., Pittsburgh, Pa. Called Watson-Standard's 16-093, the plastisol is primarily adaptable to either cold dip or hot dip applications and is said to be ideal for racks, tote baskets, tank linings, valve parts, shelving, and other metallic surfaces where chemical resistance is of prime importance.

The plastisol is resistant to such corrosive materials as oils, greases, acids, alkalies, organic salts, and petroleum solvents. It is black in color, but can be supplied in other colors. Reported physical data for it include a durometer of 60-65 Shore A, a specific gravity of 1.20-1.25, and a tensile strength of 1800 psi. when properly cured.

Neoprene-Silicone Insulation Coating

A protective coating for thermal insulation materials composed of blends of neoprene, silicone rubbers, and certain resins has been placed on the market by West Chester Chemical Co., West Chester, Pa. Called "Lagz," the coating, applied by brush, spray gun, or trowel, has a high degree of mechanical strength and is resistant to moisture, oils, brine, solvents, corrosive gases, chemicals, and weathering, it is claimed.

"Lagz" is available in two grades: No. 1 is a medium-viscosity material designed for use with 85% magnesia, calcium silicate, felt, rock wool, and asbestos; No. 2 is a high-viscosity material designed for use with low-temperature insulation such as cork, foamed plastics, glass fiber, and cellular glass.

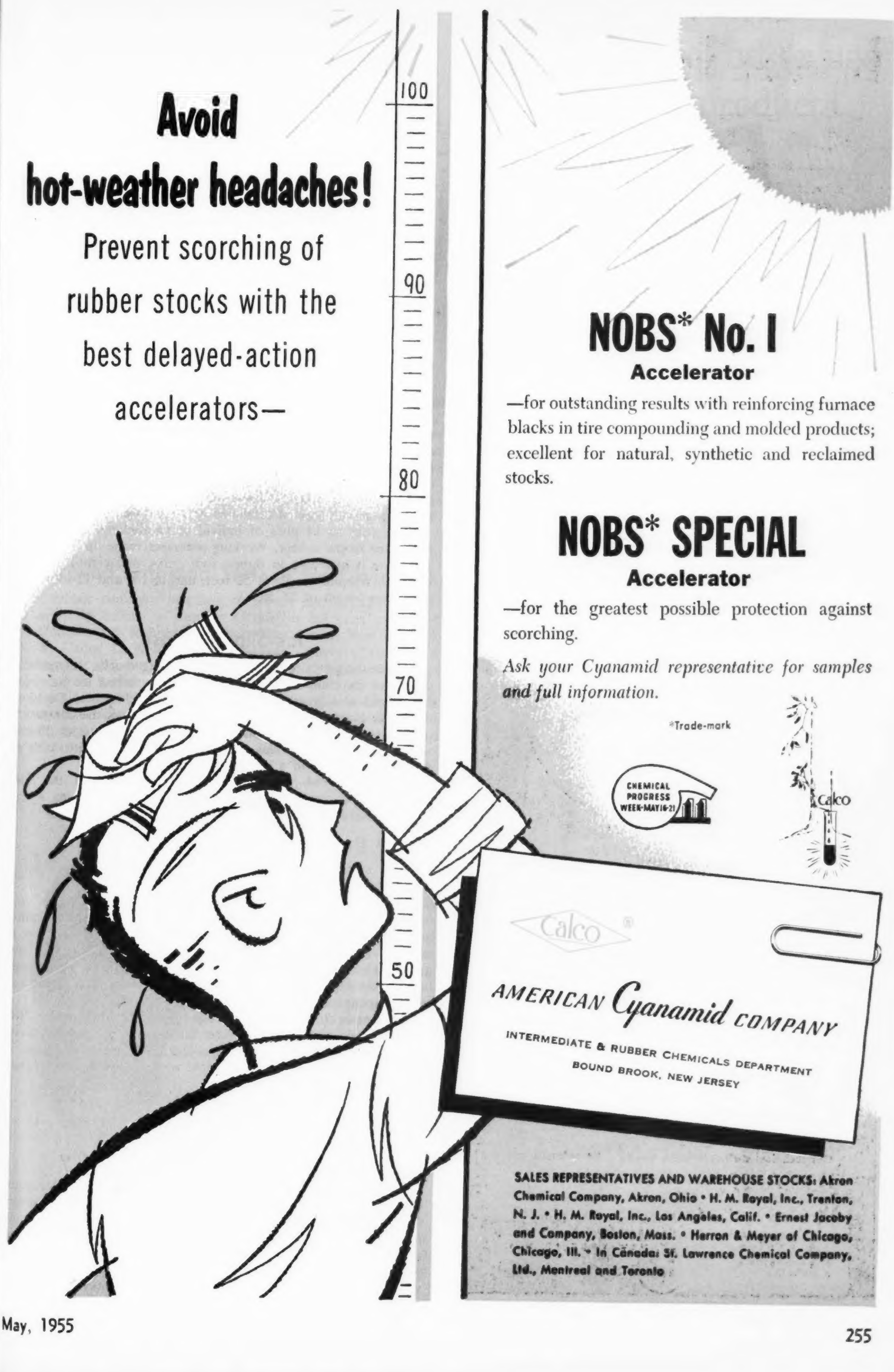
"Lagz" is non-flammable and non-toxic and can act as a powerful adhesive for fastening insulation to surfaces and for cementing the edges of formed insulation without the use of wire ties or bands, thus lowering the cost of labor and materials. Its elasticity enables it to expand or contract with changing temperatures.

Hydrophobic Kaolin—ASP 1300

Kaolin treated with a surface active agent to give it water-resistant characteristics has been placed on the market by Minerals & Chemicals Corp. of America, Metuchen, N. J. Called ASP 1300, the material also has low absorption, is easily dispersed in organic systems, and is expected to find application in the paint, rubber, ink, and reinforced plastics industries. As a class, kaolins are normally hydrophilic.

ASP 1300 is of fine particle size distribution, is water-washed, and water-fractionated. Treatment with the surface active agent

(Continued on page 261)



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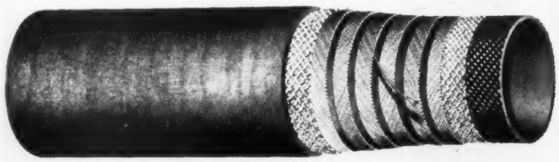
SALES REPRESENTATIVES AND WAREHOUSE STOCKS: Akron Chemical Company, Akron, Ohio • H. M. Royal, Inc., Trenton, N. J. • H. M. Royal, Inc., Los Angeles, Calif. • Ernest Jacoby and Company, Boston, Mass. • Herron & Meyer of Chicago, Chicago, Ill. • In Canada: St. Lawrence Chemical Company, Ltd., Montreal and Toronto

NEW PRODUCTS



Goodrich Type 950 Hose

Nylon-Reinforced Oil Hose

Nylon-reinforced oil discharge hose said to be 60% lighter in weight than conventional wire-reinforced hose has been placed on the market by The B. F. Goodrich Co. Industrial Products Division, Akron, O. Designated Type 950, the hose combines strength with light weight and flexibility, according to the company, and is recommended for loading oil and gasoline in dock and ship service and in refineries and distributing terminals.

From four to 14 plies of individual parallel nylon cords are embedded in the rubber. Working pressures range up to 150 psi. The hose is available in three-, four-, six-, and eight-inch sizes with a maximum length of 50 feet, and in 10- and 12-inch with maximum length of 25 feet.

Ice-Slinger Hose

An ice-slinger hose intended for loading trucks, refrigerator cars, and ice compartments of ships with crushed ice has been introduced also by the Goodrich Industrial Products Division. The hose is lined with a tube made of Armorite, the company's abrasion-resistant rubber which is said to outwear steel 20-to-1 in many applications. This hose is also reinforced with folds of fabric locked around a spiral wire in the hose wall.

Available in two-, 2½, three-, and four-inch sizes, the hose operates as a suction medium up to full vacuum or as a discharge hose up to 30 psi. pressure.

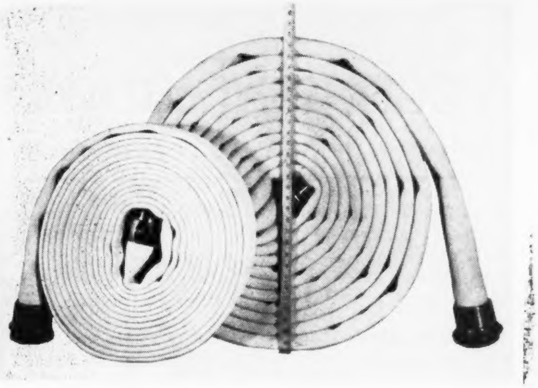
Goodyear Sports Car Tires

An all-nylon cord tire designed for high-horsepower sports cars has been placed on the market by The Goodyear Tire & Rubber Co., Akron, O. Designated Blue Streak, the new tire also has lower cord angle of its plies, resulting in a flatter tread surface at high speeds and helping to prevent tire distortion, the company says.

The tire is currently original equipment on the Chrysler 300, which is said to have the largest horsepower rating ever given an American production passenger car. The tire is available in the 8.00-15 size only, with reversible white sidewall, either tubed or tubeless.

Ribbed Rubber Mat for Industry

A new industrial rubber mat with raised-rib design for plant safety has been introduced by Wear Proof Mat Co., Chicago, Ill. Said to be resistant to greases, alkalies, oils, alcohols, and a variety of caustic chemicals, the mat is available in two styles, Niru Shad-O-Rug and Niru Cross-Rib Runner, white or grey, in widths of 36 and 48 inches for the latter, and a 48-inch width for the former. Lengths of up to 60 feet may be obtained.



Hamilton Rubber's Dacron fire hose, front, and conventional hose

Dacron Filler Cord Fire Hose

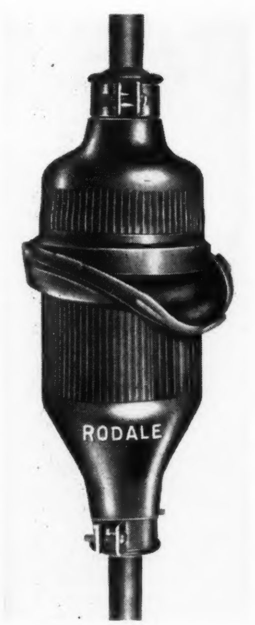
A fire hose employing filler cords of Dacron, du Pont's polyester fiber, has been introduced by Hamilton Rubber Mfg. Corp., Trenton, N. J. Called Flexrite Fire Hose, its Dacron construction in both inner and outer jackets is said to make it 20% lighter than conventional hose, and it can be folded or coiled into a smaller area for a saving of space.

The hose is supplied in 1½- and 2½-inch sizes and supports a water pressure of 400 psi. A 600 psi. hose is also available.

Improved Gripping Surface for Conveyor

A rubber conveyor belt said to permit the carriage of merchandise up inclines as steep as 45 degrees has been introduced by United States Rubber Co., Rockefeller Center, New York 20, N. Y. Called U. S. SteepGrade Package Conveyor, the belt is reported to be surfaced by about 960 gripping cleats to the square foot; it cleans itself when flexed over pulleys.

Manufactured in widths up to 48 inches, the new belting is expected to find application in mail-order houses, department stores, super markets, airports, breweries, and in warehouses in a variety of industries, according to the company.



Flip Seal Connector

Electrical Connectors with Sealing Lip

Electrical connectors designed to give maximum protection against moisture, dirt, dust, metal particles, and other conditions which may interrupt the flow of current have been placed on the market by Rodale Mfg. Co., Inc., Emmaus, Pa. Called Flip Seal, the connectors are fabricated of phenolic resin encased in natural rubber compound or neoprene; they incorporate a flexible rubber lip on the male component which flips over the female component, providing a locking action.

A company test showed no impairment of the current flow while the connectors and cable were submerged in a brine solution for one week. The product is approved by Underwriters' Laboratories and is available in 10 sizes and types, in both natural rubber and neoprene composition.

TECHNICAL BOOKS

BOOK REVIEWS

"Adhesion and Adhesives—Fundamentals and Practice," Edited by F. Clark, John E. Rutzler, and Robert Savage. John Wiley & Sons, Inc., New York, N. Y. Cloth, 8½ by 11¼ inches, 229 pages. Price, $9.75.

The volume consists of edited papers read at a symposium sponsored by Case Institute of Technology, Cleveland, O., April 24-25, 1952, and the contributions and discussions from England's Society of Chemical Industry's conference, held in London, April 22-24, 1952. The purpose of both conferences was to bridge the gap between new product research and the development of better adhesives, with the emphasis on theory. The 43 papers cover such topics as joint strength, solid-solid interfaces, fluids, and molecular and intermolecular forces. Fields covered include plastics, rubber, wood, paper, glass, roads, films, aircraft, metals, and textiles. This book is illustrated with photographs, tables, and graphs.

"Chemical Business Handbook." John H. Perry, Editor-in-Chief. McGraw-Hill Book Co., Inc., New York, N. Y. Cloth, 7½ by 10½ inches, 1330 pages. Price, $17.00.

This volume takes the whole complex world of chemical industry as its scope and neatly divides and subdivides its manifold phases into intensively documented segments that constitute the right source for the right reader at the right time. The work of 124 contributors, the book is arranged in 20 major sections into a sort of microcosm, depicting the life and times of a chemical company, from the finance needed to give it birth, through cost accounting, commercial development, research, market research, purchasing, production, traffic and transportation, sales, advertising, credits and collection, personnel management, public relations, business law, patents, industrial toxicology, insurance, and report writing, to the business mathematics that judge its prosperity or failure. This volume is heavily illustrated with tables, charts, graphs, glossaries of terms, and sample business forms.

"Principles of Emulsion Technology." Paul Becher. Reinhold Publishing Corp., New York, N. Y. Cloth, 4¾ by 7 inches, 158 pages. Price $2.95.

Written for the technically trained student of the subject, not for the professional worker in the field, the book covers such aspects of emulsion technology as dispersions and emulsions, surface activity, theory of emulsions, chemistry of emulsifying agents, emulsification equipment, testing of emulsion properties, emulsion formulation, and demulsification. Despite his systematic and well-documented approach to all phases of the subject, the author considers the practical formulation of emulsions as an art instead of a science, a view he neatly carries over into his textual matter, which is well written and spiced with lively chapter subheads gleaned from Biblical and literary sources.

NEW PUBLICATIONS

"M/41A Controller." Bulletin 5A-13. Foxboro Co., Foxboro, Mass. 12 pages. Specifications, construction, and operation of the firm's new Model 41A pneumatic indicating controller for the control of process variables such as temperature, pressure, liquid level, and humidity are included here.

Publications of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.:

"Sulfurless Natural Rubber Latex Cures." BL-280. R. W. Ward. 6 pages. Two recipes for making self-curing natural rubber compounds with high strength and low modulus by means of incorporating Zenite Special, Tetrone A, and Thionex, and no added sulfur, are reported here, together with voluminous stress-strain test data.

"Acceleration of the W Types of Neoprene." BL-281. R. M. Murray. 7 pages. A comparison of various accelerators employed in Neoprene Type W compounding, as well as an approximation of the processing safety and cure rate to be expected from their use, is discussed.

"Thionex-MBTS Acceleration of GR-S Camelback." BL-282. W. J. Schrantz and M. F. Torrence. 3 pages. A sample recipe for compounding an optimum GR-S camelback stock using a combination of Thionex and MBTS as accelerator is given, together with physical properties of the resulting stock upon immediate and ten-month-postponed curing.

"Neoprene Tubeless Tire Valves." BL-283. J. P. Munn. 8 pages. The preparation and performance of tubeless tire valves made of blended Neoprene Types WRT and WHV are reported, and their improved resistance to ozone over natural rubber and GR-S is illustrated.

"Symposium on Carbon Blacks Read at the Fall Meeting of the Swedish Institution of Rubber Technology, November 26, 1954." Sveriges Gummitekniska Förening, Stockholm, Sweden. About 130 pages, mimeographed. All but one of the eight papers presented at the above meeting, which have been collected together in the present publication, are in English. Papers by I. Drogin, United Carbon Co.; C. W. Sweitzer, Columbian Carbon Co.; L. D. Carver, Witco Chemical, and R. A. Reinke, Witco Continental Carbon; H. J. Collyer, Cabot Carbon, Ltd.; and J. Willums, Phillips Chemical Co., have been reported on in RUBBER WORLD, the first on page 514 of the January, 1955, issue, and the remaining four, on page 648 of the February, 1955, issue. "Influence of Carbon Black on Oxidation, Hysteresis, and Wear of Rubber," was discussed by G. J. van Amerongen, of Rubber Stichting, Delft, Netherlands; while N. C. H. Humphreys spoke on "Technical and Economic Aspects of Blends of Carbon Blacks." The single paper in German, by H. Westlinning, deals with investigations in the laboratories of Degussa Co. on the behavior of active carbon during compounding and the static and dynamic properties of the rubber vulcanizates.

"Methylene Chloride, Chloroform, Methyl Chloride, Carbon Tetrachloride." Solvay Process Division, Allied Chemical & Dye Corp., New York, N. Y. 26 pages. The physical and chemical properties and applications of the firm's chloromethanes are presented in this booklet.

"Curing Systems for Hycar 1042." Hycar Technical Newsletter Vol. 4, No. 1. B. F. Goodrich Chemical Co., Cleveland, O. 8 pages. Physical test data on compounded Hycar 1042 nitrile subjected to a variety of curing conditions are reported here.

"Silastic Newsletter." Vol. III, No. 1. Dow Corning Corp., Midland, Mich. 13 pages. This is the Newsletter's annual review issue, containing digests of data published since April, 1954, on the applications, processing, and properties of Silastics.

"Indonex Plasticizers in Extruded Bumper Compounds." Circular 13-51. Indoil Chemical Co., Chicago, Ill. 5 pages. Sample GR-S recipes for making extruded and molded bumper compounds employing Indonex plasticizers, together with the resultant physical properties and test data of these compounds, are reported in this folder.

"The Defense Materials System in Our American Industry." United States Department of Commerce, Business & Defense Services Administration, Washington, D. C. 46 pages. Price 25¢. This handbook of the Defense Materials System contains a detailed description of the System, as well as instructions for defense contractors and key questions and answers.

"New Patapar Releasing Parchments." Paterson Parchment Paper Co., Bristol, Pa. This brochure contains descriptive inserts and samples of the firm's vegetable parchments recommended as protective backing for such goods as pressure-sensitive tape, uncured rubber, rubber tape, and tacky material.

"Hystrene and Industrene." H-1221. Trendex Division, HumKo Co., Memphis, Tenn. 4 pages. This is a chart comparing the specifications of the company's Hystrene and Industrene fatty acids and its glycerides.

"Nitrex 2615." Bulletin 2615. Naugatuck Chemical Division of United States Rubber Co., Naugatuck, Conn. 4 pages. The properties and processing of Nitrex 2615, a latex that has found application in the fields of textiles, paper coating, non-woven fabrics, adhesives, and tape release coating, are reported here.

"ASTM Standards on Electrical Insulating Materials (With Related Information)." The American Society for Testing Materials, Philadelphia, Pa. Paper cover, 6 by 9 inches, 660 pages. Price, $5.50. This latest volume includes 60 test methods, 17 specifications, three recommended practices, and a list of definitions. Thirty-three of the designations are new or have been revised since the last edition.

"How You Can Lay a Rubber Tile Floor." The Rubber Manufacturers Association, Inc., New York, N. Y. This folder describes the advantages of a rubber tile floor and gives step-by-step instructions on how to lay one.

"Tlargi 1955 Yearbook." The Los Angeles Rubber Group, Inc., Los Angeles, Calif. 94 pages. The Yearbook contains a record of the multifarious social and technical activities of the organization during 1954, names and affiliations of the members, West Coast rubber manufacturers and distributors, and a variety of technical articles and data.

"Sarco Thermodynamic Steam Traps." Bulletin No. 255-A. Sarco Co., Inc., New York, N. Y. 4 pages. Specifications of the firm's Type TD thermodynamic steam traps are presented.

"Newsletter." April 1, 1955. Rubatex Products, Inc., New York, N. Y. 3 pages. This letter is the continuation of a previous discussion of closed-cell rubber manufacture and treats of the choice of recipe and details of the mixing operation.

"Oil Hose," "Welding Hose," "Air Hose," and **"Steam Hose."** Boston Woven Hose & Rubber Co., Boston, Mass. 8, 2, 4, and 4 pages, respectively. Photographs and specifications of the firm's hose are included in these publications.

"Preventive Maintenance Manual for V-Belt Drives." The Dayton Rubber Co., Dayton, O. 24 pages. Suggestions for properly installing and maintaining V-belts are contained in this illustrated booklet.

"Bausch & Lomb Stereomicroscopes." Catalog D-15. Bausch & Lomb Optical Co., Rochester, N. Y. 38 pages. Photographs, specifications, and specific applications of the company's stereomicroscopes and accessories for three-dimensional microscopic viewing are contained in this brochure.

"Misguided Missiles." The Travelers Insurance Cos., Hartford, Conn. A multitude of accident statistics for the years 1953 and 1954 caused by that most lethal of all man's weapons, the automobile, is presented in this safety publication, which is satirically illustrated by cartoonist Chon Day.

"Antara Catalogue." Antara Chemicals, sales division of General Aniline & Film Corp., New York, N. Y. 40 pages. The firm's detergents, wetting agents, emulsifiers, brighteners, sequestrants, and dyeing assistants are catalogued here.

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Hydrophobic Kaolin

(*Continued from page 254*)

gives it improved wetout, reduced viscosity, low mixing time, and a minimum tendency to agglomerate—ideal attributes for use with organic systems, the company says.

Significant data on the material follow:

Particle size average, micron	0.55
Oil absorption (ASTM D281-31)	31-32
Maximum moisture, %	1.0
pH (TAPPI Tentative Standard T 645 m-54)	6.5-7.5
Color (brightness), minimum %	85.5
Specific gravity	2.58
Particle size distribution, % by weight	
0-½ micron	44
½-1 micron	28
1-2 microns	20
2-5 microns	8
Residue 325 mesh maximum %	0.02

MARKET REVIEWS

Rubber

Activity on both spot and futures markets during the period from March 16 to April 15 decelerated sharply to lower levels as major consumers at first awaited the Congressional transfer of synthetic facilities to private hands, then continued to mark time in an effort to sense price trends after the transfer had finally been voted upon and approved at the end of March. Coupled with this watch-and-wait policy was the lull that blanketed the market over the Easter holidays, as well as the natural overstocking that had taken place while rubber prices were skidding in February and March.

The result was an abnormally stable spot market during the March 16-April 15 period, with a high-low price differential of a mere 2¢ a pound for R.S.S. #1, and only 30,200 tons traded on the futures market.

Typically, prices on the foreign cables were behind the American trend, being too high for local acceptance, and resulting in at least one interesting political development. It was reported from Colombo, Ceylon, that shippers were holding on to some 3,000 tons of sheet rubber because the world price level was now below that of the Red China barter price. Should the Western buying price remain low or sink lower, these 3,000 tons, as well as other quantities that may become available later, were duly expected to embark for the China coast.

Of this writing, it may be supposed that natural rubber prices will in the immediate future sustain a calm decline characteristic of the warm weather months. Demand will slacken because of normal cutbacks in automotive production and throughout industry generally, and because of the rash of strikes that are typical of the American labor scene this time of year. In addition, the private synthetic industry will undoubtedly make every effort to surpass former government production quotas, even from the outset, encouraging consumers to continue the increasing trend to synthetics. No paper prognostication, however, can remain intact in a world of sudden political developments, and a shattering of the current Far Eastern calm will send prices scurrying up again.

On the New York Commodity Exchange, sales for the second half of March were 19,190 tons, bringing the monthly figure to 43,760 tons. Sales during the first half of April amounted to 11,010 tons. Near May stocks began the period at 31.95¢ a pound and were at the same level on April 15, a high of 32.60¢ having been reached on April 12 and a low of 30.20¢ on April 1.

COMMODITY EXCHANGE
WEEK-END CLOSING PRICES

Futures	Mar. 19	Mar. 26	Apr. 2	Apr. 9	Apr. 16
May	30.45	31.55	30.20	32.35	31.95
July	30.00	31.16	30.00	31.55	31.10
Sept.	29.60	30.75	29.65	31.20	30.50
Dec.	29.15	30.45	29.30	30.75	30.05
1956					
Mar.	28.80	30.10	28.90	30.40	29.60
May	28.45	29.75	28.50	30.00	29.20
Total weekly sales, tons	7,630	10,120	2,350	3,810	4,850

On the physical market, R.S.S. #1 began the period at 32.38¢ a pound, fell to 31.25¢ on March 22, rose to 32.50¢ on March 28, declined again to the period's low of 30.75¢ on April 1, then recovered to the period's peak of 32.75¢ on April 12, ending at 32.25¢ on April 15.

March monthly average spot prices for certain grades were as follows: R.S.S. #1, 31.54¢; R.S.S. #3, 31.33¢; #3 Amber Blankets, 29.27¢; and Flat Bark, 27.21¢.

NEW YORK SPOT MARKET
WEEK-END CLOSING PRICES

	Mar. 19	Mar. 26	Apr. 2	Apr. 9	Apr. 16
R.S.S.: #1	31.50	32.00	30.75	32.00	32.25
2	31.38	31.88	30.63	31.88	32.13
3	31.25	31.75	30.50	31.75	32.00
Latex Crepe					
#1 Thick	33.88	34.38	33.50	34.75	35.00
Thin	33.63	34.13	33.25	34.50	34.75
#3 Amber Blankets	28.88	29.13	28.00	29.13	29.13
Thin Brown Crepe	28.63	28.88	27.75	28.88	28.88
Flat Bark	26.50	26.75	26.00	27.13	27.00

Latex

Consumption of *Hevea* and synthetic latices continued high during the period from March 16 to April 15 as automotive production remained at top levels. Immediate sales were difficult to achieve, and there was much unsatisfied demand for deliveries as late as July. Many big consumers were ordering latex for deliveries well into the final quarter of the year. Stocks were extremely low, and it could not be anticipated when they could be rebuilt, since there were few observers willing to predict to what extent industrial production would decline this summer.

Spot *Hevea* latex prices during the period under consideration ranged from 40 to 43¢ a pound, with July delivery prices somewhat easier, in the 38-41¼¢ bracket. GR-S latices (government produced) were 21.5-28¢ a pound for spot deliveries; neoprene latices 37-47¢; and nitrile latices 46-54¢.

Final January and preliminary February domestic statistics on latices follow:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
January	0	7,853	7,355	9,684
February	0	...	7,093	8,581
GR-S				
January	6,094	105	4,537	5,861
February	5,483	151	4,816	5,684
Neoprene				
January	617	0	661	1,067
February	797	0	744	850
Nitrile				
January	624	0	506	812
February	641	0	477	618

Scrap Rubber

Trading was moderate during the period from March 16 to April 15; most activity centered on Butyl tubes and mixed auto tires, and requests for tire buffing fell off. Trade quarters reported continuing efforts by Naugatuck to acquire mixed auto tire shipments, efforts reflected in the higher volume of such shipments to the company during the month of April.

Prices of scrap rubber exhibited unusual turnover during the period, notably a rise of at least $1 a ton on mixed auto tires, and a fall of $1-$2 on tire buffing.

Current dealers' buying prices for scrap rubber grades, in carload lots delivered to mills at the points indicated, follow:

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	$12.00	$13.00
S. A. G. auto tires	Nom.	13.00
Truck tires	Nom.	14.00
Peelings, No. 1	40.00/41.00	40.00/42.00
2	Nom.	Nom.
3	15.50	Nom.
Tire buffing	16.00	13.00/14.00
	(¢ per Lb.)	
Auto tubes, mixed	4.25	4.25
Black	5.00	5.25
Red	7.00	7.00
Butyl	4.75	5.25

Reclaimed Rubber

The reclaimed rubber market continued vigorous during the period from March 16 to April 15; at least one producer reported the volume of its sales in March as the highest in its history. April is expected to be another good month, though perhaps not up to March levels, and industry-wide optimism for the near future is freely expressed. Strikes in the automotive industry are not anticipated.

Reclaim prices were unchanged.

RECLAIMED RUBBER PRICES

	Lb.
Whole tire: first line	$0.10
Fourth line	.0875
Inner tube: black	.15
Red	.21
Butyl	.15
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Rayon

Total calculated production of rayon and acetate yarn during March was 79,300,000 pounds, of which 41,900,000 pounds were regular-tenacity yarn, and 37,400,000 pounds were rayon high-tenacity yarn. Shipments of yarn amounted to 85,100,000 pounds, of which 46,000,000 pounds were regular-tenacity yarn and 39,100,000 pounds were rayon high-tenacity yarn.

Month-end stocks were as follows: regular-tenacity, 38,100,000 pounds; rayon high-tenacity, 6,500,000 pounds; and total yarn, 44,600,000 pounds. These figures represented increases over February for both production and shipments; stocks, however, showed slight decreases.

For the first quarter of this year, shipments of rayon and acetate yarn plus staple plus tow have totaled 329,200,000 pounds, or 30% greater than the comparable 1954 shipments of 253,400,000 pounds and 10% more than for the first quarter of 1953.

The price of Fortisan-36, a super-strong industrial rayon fiber in 800 denier size, recently developed by Celanese Corp. of America, has been set at $1.50 a pound.

The 3-5¢ price rise in its high-tenacity and super-high-tenacity rayon yarns which was announced last month by E. I. du Pont de Nemours & Co., Inc., has been canceled because competitive companies had not boosted the price of their products.

Current prices per pound for rayon tire yarns and fabrics follow:

RAYON PRICES

Tire Yarns

High Tenacity		
1100/ 480	$0.62	
1100/ 490	.62	
1150/ 490	.62	
1165/ 480	.63	
1230/ 490	.62	
1650/ 720	.61	
1650/ 980	.61	
1875/ 980	.61	
2200/ 960	.60	
2200/ 980	.60	
2200/1466	.67	
4400/2934	.63	
Super-High-Tenacity		
1650/ 720	.64	
1900/ 720	.64	
Tire Fabrics		
1100/490/2	.72	
1650/980/2	.695 /	.73
2200/980/2	.685	

Cotton Fabrics

Trading on the industrial fabric market was dull to fair during the period from March 16 to April 15, with substantial activity limited to certain types of wide drills, broken twills, Army ducks, enameling ducks, and chafers. Observers reported an easiness in delivery schedules ranging through the second and third quarters of the year and did not appear perturbed at the possibility of spring strikes in the textile industry, on the one hand, and among automobile manufacturers on the other.

Fairly substantial quantities of industrial gray cloths for use in autos were being purchased for delivery in May and June at the period's end, but finishing and coating of these goods were expected to be held in abeyance until current labor negotiations would be completed. Most union contracts in the auto industry begin expiring at the end of May.

In the main, prices on most fabrics held fairly steady during the period.

COTTON FABRICS

Drills		
59-inch 1.85 yd. ... *yd.*	$0.37	$0.375
2.25-yd.	.32 /	.325
Ducks		
38-inch 1.78-yd. S.F. *yd.*	nom.	
2.00-yd. D.F.	nom.	
51.5-inch, 1.35-yd. S.F.	nom.	
Hose and belting	.67	
Raincoat Fabrics		
Printcloth, 38½-inch,		
64x60, 5.35-yd. *yd.*	$0.1425/	$0.145
6.25 yd.	.12	
Sheeting, 48-inch, 4.17-yd.	.20	
52-inch, 3.85-yd.	.22	
Osnaburgs		
40-inch 2.11-yd. ..... *yd.*	.245	
3.65-yd	.155	
Chafer Fabrics		
14.40-oz/sq. yd. Pl. *yd.*	.70	
11.65-oz./sq. yd. S.	.61	
10.80-oz./sq. yd. S	.6575	
8.9-oz./sq. yd. S.	.67	
Other Fabrics		
Headlining, 59-inch,		
1.65-yd., 2-ply *yd.*	.465	
64-inch, 1.24-yd., 2-ply	.595	
Sateens, 53-inch, 1.32-yd.	.54	
58-inch, 1.21-yd.	.59	

FFC Memo to Buyers; Transferred Synthetic Inventory

Federal Facilities Corp., Office of Synthetic Rubber, advises that in accordance with Public Law 19 it will continue to operate the Baytown, Tex., copolymer plant (Plancor 877) until a transfer of the facilities to private hands can be arranged and will therefore continue to sell GR-S 1600, 1601, 1602, and 1801 to the public. No other rubbers will be made by the government. Sales on a firm contract basis, however, have been discontinued, and accordingly, the "General Sales and Distribution Circular for Government Synthetic Rubbers" has been amended.

Orders for the above named GR-S rubbers should be in the FFC's office not later than the twelfth day of the month preceding the month in which delivery is desired.

FFC referred to its Memorandum to All Rubber Purchasers, dated January 25, 1955, in which it was stated that in the event of sale of the synthetic rubber plants to private industry, FFC would furnish each consumer with a list of plant purchasers, together with the types of synthetic rubber that each will purchse as his share of FFC's final inventory. This information is contained in the accompanying table.

Plant Purchaser	Location of Synthethic Rubber Plant or Plants Purchased	GR-S Types
American Synthetic Rubber Corp. 370 Lexington Ave. New York 17, N. Y.	Louisville, Ky.	1001, 1004, 1006, 1009, 1010, 1013, 1014, 1016, 1018, 1019, 1021, 1500, 1502, 1503, 1601, 1703, 1708, 1712, 1801
Copolymer Corp. P. O. Box 1029 Baton Rouge 1, La.	Baton Rouge, La.	1500, 1502, 1505, 2101, 2102
Firestone Tire & Rubber Co. Akron 17, O.	Akron, O., and Lake Charles, La.	1000, 1001, 1002, 1004, 1005, 1006, 1009, 1010, 1012, 1013, 1014, 1015, 1500, 1502, 1703, 1705, 1710, 1712
Goodrich-Gulf Chemicals, Inc. Gulf Bldg. Pittsburgh 30, Pa.	Port Neches, Tex.	1001, 1002, 1006, 1500, 1501, 1502, 1705
Goodyear Synthetic Rubber Corp. 1144 Market St. Akron 16, O.	Akron, O., and Houston, Tex.	1000, 1007, 1009, 1012, 1015, 1018, 1100, 1500, 1502, 1503, 1601, 1703, 1707, 1708, 1710, 1712, 1801, 2004
Phillips Chemical Co. Bartlesville, Okla.	Borger, Tex.	1004, 1009, 1010, 1018, 1100, 1503, 1600, 1703, 1706, 1708, 1711, 1712, 1801
Shell Chemical Corp. RCA Bldg. 30 W. 50th St. New York 20, N. Y.	Los Angeles, Calif.	1000, 1001, 1002, 1006, 1009, 1010, 1013, 1018, 1100, 1500, 1501, 1502, 1503, 1600, 1602, 1703, 1705, 1706, 1707, 1708, 1709, 1712, 1801, 2000, 2004
Texas-U. S. Chemical Co. 135 E. 42nd St. New York 17, N. Y.	Port Neches, Tex.	1010, 1100, 1505, 1600, 1703, 1707, 1708, 1709, 1711, 1801
United States Rubber Co. 1230 Avenue of the Americas New York 20, N. Y.	Naugatuck, Conn.	1009, 1016, 1018, 1019, 1021, 1022, 1023, 1503, 1504, 2000, 2001, 2002, 2101, 2103, 2104, 2105, 2106, X767
		GR-I Types
Esso Standard Oil Co. Baton Rouge, La.	Baton Rouge, La.	*
Humble Oil & Refining Co. Baytown, Tex.	Baytown, Tex.	*

*Enjay Co., Inc., 15 W. 51st St., New York 19, N. Y., will be the selling agent for all types of GR-I.

The amendment to the "General Sales and Distribution Circular for Government Synthetic Rubbers" follows:

All requests for shipment of synthetic rubber to be made during May, 1955, and any calendar month thereafter shall have typed or stamped thereon the statement: "This Order is subject to the General Sales and Distribution Circular for Government Synthetic Rubbers, as amended April 15, 1955."

Such requests, to be dated, numbered, and executed by each purchaser, shall always be deemed and construed to contain only the above insert statement, statements of the type and quantity of synthetic rubber requested, the destination, and the requested shipping dates, notwithstanding any other statements therein or contents thereof. Separate requests shall be submitted for each calendar month, and the specific shipping dates requested in any such requests shall be confined to such month. All requests must be addressed to Federal Facilities Corp., Office of Synthetic Rubber, Sales Division, 811 Vermont Ave., N.W., Washington 25, D.C.

If routing instructions are not received by The General Tire & Rubber Co., Baytown, Tex., ("Agent") prior to the shipping date set forth in the shipping order, the Agent may ship the synthetic rubber by way of rail, truck, water, or combination thereof by the most economical route, and neither FFC nor the Agent shall be liable for any loss, damage, or delay which may result from the selection of a particular route or mode of transportation.

A copy of each shipping order will be forwarded to the prospective purchaser as a courtesy acknowledgment of the request. Shipping orders of prospective purchasers who have established credit will be perforated to indicate that the material may be shipped on a 30-day credit basis.

Upon receipt by the prospective purchaser of a copy of the shipping order, he shall immediately forward to the Agent detailed routing instructions. If credit has not been established, cash-equivalent funds payable to FFC covering the price set forth in the shipping order and the uniform freight charge must be received by the Agent prior to shipment.

It is understood, however, that neither the FFC nor the Agent, shall have any obligation or liability for failure ever to ship or deliver all or any portion of the synthetic rubber listed in any request or shipping order. Cancellation of any undelivered quantity must be submitted in writing, or the FFC shall have the right to make deliveries at any time.

In the event FFC increases or decreases the purchase price beyond or below the price set forth in a particular shipping order, notice shall be given to a prospective purchaser, and no deliveries shall thereafter be made until written notice is received by the Washington office of FFC that the prospective purchaser will pay the new price for the deliveries.

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The Goodyear Tire & Rubber Co., chemical division, Akron, O., has appointed General Latex & Chemical Corp., Cambridge, Mass., as United States sales representative of its GR-S latices.

PVC Foam

(Continued from page 225)

plasticizer system will be a so-called plastisol, a fluid dispersion of fine particle-size resin in a plasticizer medium, prepared by stir-in or ink-mill techniques. In the case of firmer sponges, either solid plasticizers or low ratios of liquid plasticizer will be employed, and hot mill mixing is used to prepare a homogeneous dispersion, with due regard being paid to maintaining a temperature under the minimum decomposition temperature of the blowing agent.

The dispersion in either case is fed into a mold, which is then closed, and the composition expanded by decomposing the blowing agent at a temperature usually above 300° F. in a suitable press to counterbalance the pressure developed. The mold is cooled, still in the press, under pressure to below 200° F., and the green sponge article is then discharged and finally expanded in an oven at about 210° F. The blowing agents are organic nitrogen compounds, characteristically nitroso, hydrazide, or azo derivatives, and the blowing action results from release of nitrogen during the fusion cycle.

Contrasted to this process is one currently receiving wide attention, the broad details of which are disclosed in United States patent No. 2,666,036, issued to Elastomer Chemical Corp. Here an inert gas is injected into a fluid dispersion of vinyl resin in plasticizer, and the mass discharged in a foamed state at a temperature under the gelling temperature of the composition. In practice, the expanded wet plastisol is then fused at a temperature in excess of 300° F., usually in a dielectric field. Characteristically, this process produces open-celled or foam polyvinyl compositions.

Intermediate between these two methods is a du Pont process which employs a chemical blowing agent and a supplement to produce foam or interconnecting-cell polyvinyl chloride compositions at atmospheric pressure. Fluid dispersions of resin in plasticizer are employed. Recent advances have removed the early restriction to polymeric plasticizer systems, and conventional monomerics may be used. For optimum results, practice of this process demands a two-stage blowing operation wherein initial expansion at a temperature under the gelation temperature of the plastisol is followed by full fusion at 320-350° F.

The products prepared by these three methods differ only in physical properties in the sense that the lowest densities (minimum 2-3 pounds/cu. ft.) are attainable in closed cell sponge; whereas the types cured at atmospheric pressures have reached a minimum of four pounds/cu. ft. in the case of the Elastomer type of foam, and somewhat above this in the case of the chemically blown type.

The closed-mold procedure is a custom, discontinous operation, and inherently a premium manufacturing method. By contrast, both atmospheric pressure processes offer the prospect of continuous operation. Single-stage fusion and expansion by means of 4¢ carbon dioxide rather than a relatively expensive organic have led us to believe that the Elastomer process offers the most promising method for establishing polyvinyl chloride foam as a bulk product likely to compete in the volume markets.

(To be Continued)

Financial

(Continued from page 240)

Hewitt-Robins, Inc., Stamford, Conn., and domestic subsidiaries. Year ended December 31, 1954: net earnings, $857,-596, equal to $2.82 each on 287,051 common shares, compared with $1,231,-696, or $4.29 a share, the year before; net sales, $35,588,613, against $38,494,-309; current assets, $14,467,378, current liabilities, $4,563,764, against $15,648,023 and $5,291,105, respectively, on December 31, 1953.

McNeil Machine & Engineering Co., Akron, O. For 1954: net profit, $2,829,148, equal to $5.14 a share, contrasted with $1,668,435, or $3.34 a share, in 1953.

Monsanto Chemical Co., St. Louis, Mo., and consolidated subsidiaries. First three months, 1955: net income, $8,757,702, equal to $1.63 a common share, compared with $5,888,948, or $1.09 a share, in the like period last year; sales, $102,175,547, against $82,931,351.

National Automotive Fibres, Inc., Trenton, N. J. March quarter, 1955: net earnings, $985,866, equal to $1.00 each on 988,145 capital shares, contrasted with $376,264, or 38¢ each on 996,146 shares, in the 1954 quarter; sales, $23,320,191, against $17,370,011.

New Jersey Zinc Co., New York, N. Y., and subsidiaries. For 1954: net income, $3,092,657, equal to $1.58 each on 1,960,-000 capital shares, compared with $2,713,-887, or $1.38 a share, in 1953; sales, $14,-704,391, against $12,085,803; income taxes, $1,426,000, against $975,000.

O'Sullivan Rubber Corp., Winchester, Va. March quarter, 1955: net income, $68,149, equal to 9¢ a common share, contrasted with $123,591, or 23¢ a share, in last year's period.

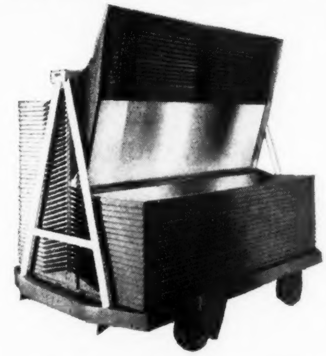
Phelps Dodge Corp., New York, N. Y. Quarter ended March 31, 1955: net income, $15,200,000, equal to $1.50 a share, against $10,400,000, or $1.03 a share, in the 1954 months.

Stauffer Chemical Co., New York, N. Y., and consolidated subsidiaries. Year to December 31, 1954: net income, $5,726,-377, equal to $2.44 a common share, against $5,464,442, or $2.31 a share, a year earlier; net sales, $82,581,499, against $76,638,427; federal income taxes, $4,790,-000, against $4,735,000.

(Concluded on page 276)

S P A D O N E

SPRING LEAF TRUCKS



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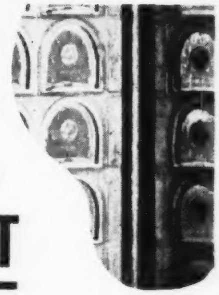
Sturdily built to give years of economical, maintenance-free service, these trucks save valuable floor space and expedite handling and in-plant transportation of materials. Light-weight "Floating-action" trays raise or lower quickly—no locking devices necessary—aluminum or steel trays are accessible from three sides. Furnished completely assembled and ready for use; in a wide range of standard sizes, or *specially made to meet individual requirements.* Write for complete information.

SPADONE MACHINE CO. INC.

SOUTH NORWALK, CONN. PHONE: VOlunteer 6-1087

Rubber Molds Cleaned And Brightened BEST with Oakite RUSTRIPPER!



Iron rubber molds, heavily encrusted with silicone and carbon deposits, presented a difficult cleaning problem at one large plant. The local Oakite Man was consulted. After he had carefully analyzed the problem, he suggested soaking the molds in a solution of Oakite Rustripper for 20 minutes. The results were startling. Not only was every trace of deposit removed—even from the sharp corners and indentations—but the metal molds looked as if they had been hand-polished! For further details about revolutionary Rustripper, write Oakite Products, Inc., 47 Rector St., New York 6, N. Y.

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COMPOUNDING INGREDIENTS*

Abrasives

Pumicestone, powdered	lb.	$0.025	$0.045
Rottenstone, domestic	lb.	.03	.04
Shelblast	ton	80.00	165.00

Accelerators

A-1 (Thiocarbanilide)	lb.	.50	.57
A-32	lb.	.66	.80
A-100	lb.	.52	.66
Accelerator 49	lb.	.53	.54
108	lb.	.89	
552	lb.	2.25	
808	lb.	.66	.68
833	lb.	1.17	1.19
Altax	lb.	.48	.50
Arazate	lb.	2.25	
Beutene	lb.	.66	.71
Bismate	lb.	3.00	
B-J-F	lb.	.27	.32
Butasan	lb.	1.04	
Butazate	lb.	1.04	
Butyl Accelerator 21	lb.	.89	
Eight	lb.	1.10	1.35
Zimate	lb.	1.04	
Captax	lb.	.38	.40
C-P-B	lb.	1.95	
Cumate	lb.	1.45	
Diesterex N	lb.	.50	.57
DOTG (diorthotolylguanidine)			
Cyanamid	lb.	.57	.58
Du Pont	lb.	.57	.58
DPG (diphenylguanidine)			
Cyanamid	lb.	.48	.49
Monsanto	lb.	.48	.55
El-Sixty	lb.	.58	.65
Ethasan	lb.	1.04	
Ethazate	lb.	1.04	
50-D	lb.	.85	
Ethyl Thiurad	lb.	1.04	
Tuads	lb.	1.04	
Tuex	lb.	1.04	
Zimate	lb.	1.04	
Ethylac	lb.	.93	.95
Hepteen	lb	.44	.50
Base	lb.	1.85	
Ledate	lb.	1.04	
MBT (2-mercaptobenzothiazole)			
American Cyanamid	lb.	.38	.40
Du Pont	lb.	.38	.40
Naugatuck	lb.	.38	.43
-XXX, Cyanamid	lb.	.49	.51
MBTS (mercaptobenzothiazyl disulfide)			
Cyanamid	lb.	.48	.50
Du Pont	lb.	.48	.50
Naugatuck	lb.	.48	.53
-W Cyanamid	lb.	.53	.55
Mertax	lb.	.49	.56
Methasan	lb.	1.04	
Methazate	lb.	1.04	
Methyl Tuads	lb.	1.14	
Zimate	lb.	1.04	
Monex	lb.	1.14	
Mono-Thiurad	lb.	1.14	
Morfex	lb.	.65	.70
MT	lb.	1.00	
NOBS No. 1	lb.	.69	.71
Special	lb.	.74	.76
O-X-A-F	lb.	.49	.54
Pentex	lb.	1.04	
Flour	lb.	.21	
Permalux	lb.	2.17	
Phenex	lb.	.52	.59
Pip-Pip	lb.	2.07	
R-2 Crystals	lb.	4.35	
Rotax	lb.	.49	.51
RZ-50, -50B	lb.	1.00	
S. A. 52	lb.	1.14	
57, 62, 67, 77	lb.	1.04	
66	lb.	2.50	
Santocure	lb.	.69	.76
NS	lb.	.75	.82
Selenacs	lb.	2.60	
SPDX-GH	lb.	.69	.74
GL	lb.	1.20	1.34
Tellurac	lb.	1.21	
Tepidone	lb.	.45	
Tetrone A	lb.	1.91	
Thiofide	lb.	.48	.55
S	lb.	.50	.57
Thionex	lb.	1.14	
Thiotax	lb.	.38	.45
Thiurad	lb.	1.14	
Thiuram E	lb.	1.04	
M	lb.	1.14	
Trimene	lb.	.56	.62
Base	lb.	1.03	1.10
Tuex	lb.	1.14	
Ultex	lb.	1.00	1.10
Unads	lb.	1.14	
Ureka Base	lb.	.66	.73
Vulcacure NB	lb.	.45	
ZB, ZE, ZM	lb.	.85	
Z-B-X	lb.	2.45	
Zenite	lb.	.48	.50
A	lb.	.49	.51
Special	lb.	.49	.51
Zetax	lb.	$0.49	$0.51
Zimate	lb.	1.04	

* Prices, in general, are f.o.b. works. Range indicates grade or quantity variations. No guarantee of these prices is made. Spot prices should be obtained from individual suppliers.

† For trade names, see Color—White, Zinc Oxides.

THIS listing of "Compounding Ingredients" has been largely expanded from previous listings in RUBBER WORLD and closely follows the classification of chemicals as found in our book, "Compounding Ingredients for Rubber." Readers are referred to this source for identification of brand names.

Government synthetic rubbers are now included in this list as well as privately produced synthetic rubbers. Suppliers using an abbreviated chemical name for their product are grouped under the abbreviated designation; while product names not using the abbreviation are listed alphabetically; for example, du Pont's MBT is under the MBT group of accelerators; whereas Vanderbilt's Captax (another 2-mercaptobenzothiazole) can be found under the C's. All latex compounding ingredients are grouped under that classification, with some sub-classification according to the physical state of the products, that is, dispersions and emulsions.

Suppliers are requested to submit product additions and price changes promptly as they occur.

EDITOR

Accelerator-Activators, Inorganic

Lime, hydrated	ton	10.00	17.50
Litharge, comml	lb.	.165	.17
Eagle, sublimed	lb.	.171	
National Lead, sublimed	lb.	.17	.18
Red lead, comml	lb.	.175	.1925
Eagle	lb.	.18	
National Lead	lb.	.18	.1925
White lead, carbonate	lb.	.165	.175
Eagle	lb.	.165	.175
National Lead	lb.	.175	.185
White lead, silicate	lb.	.16	.1925
Eagle	lb.	.175	.1925
National Lead	lb.	.16	.18
Zinc oxide, comml.†	lb.	.135	.1775

Accelerator-Activators, Organic

Aktone	lb.	.22	.23
Barak	lb.	.62	
Capital 170	lb.	.23	.27
171	lb.	.1325	.1725
700, 701	lb.	.155	.195
705, 710	lb.	.155	.195
800	lb.	.12	.14
801	lb.	.1375	.1575
802	lb.	.1425	.1625
803	lb.	.165	.185
Curade	lb.	.57	.59
D-B-A	lb.	1.95	
Emery 600	lb.	.1325	.1725
Groco 30	lb.	.1325	.1725
35	lb.	.1375	.1775
Guantal	lb.	.57	.64
Hyfac 400	lb.	.1138	.1400
430	lb.	.1513	.1775
431	lb.	.1738	.20
Hystrene S-97	lb.	.1863	.2125
T-45	lb.	.1588	.185
T-70	lb.	.1688	.195
Industrene B	lb.	.1213	.1475
R	lb.	.1138	.14
158	lb.	.1263	.1525
254	lb.	.1363	.1625
262	lb.	.1463	.1725
Laurex	lb.	.33	.37
MODX	lb.	.295	.345
NA-22	lb.	1.50	
Oleic acid, comml	lb.	.16	.195
Emersol 210 Elaine	lb.	.155	.195
Groco 2, 4, 8, 18	lb.	.155	.195
Plastone	lb.	.27	.30
Polyac	lb.	1.65	
Ridacto	lb.	.25	.26
Seedine	lb.	$0.1485	$0.1703
Stearex Beads	lb.	.1488	.1588
Stearic acid			
Emersol 120	lb.	.1363	.1625
130	lb.	.1588	.185
Hydrofol 51	lb.	.09	
Hydrogenated, rubber grade			
Groco	lb.	.12	.14
Rufat 75	lb.	.1138	.14
Single pressed, comml	lb.	.1425	.1575
Emersol 110	lb.	.1313	.1575
Groco 53	lb.	.1375	.1575
Wilmar 253	lb.	.1313	.1575
Double pressed, comml	lb.	.1475	.165
Groco 54	lb.	.1425	.1625
Wilmar 254	lb.	.1363	.1625
Triple pressed, comml	lb.	.17	.185
Groco 55	lb.	.165	.185
Wilmar 255	lb.	.1588	.185
Sterene 60-R	lb.	.09	.1075
Tonox	lb.	.515	.605
Vulklor	lb.	.75	.95
Wilmar 110	lb.	.155	.195
434	lb.	.1325	.1725
Zinc stearate, comml	lb.	.37	.42

Antioxidants

AgeBest A26	lb.	.18	.24
620-32B	lb.	.20	.26
716-30	lb.	.18	.24
1041-21	lb.	.165	.225
1293-22A	lb.	1.90	2.00
AgeRite Alba	lb.	2.35	2.45
Gel	lb.	.64	.66
H. P.	lb.	.72	.74
Hipar	lb.	.98	1.00
Powder	lb.	.52	.54
Resin	lb.	.75	.77
D	lb.	.52	.54
Spar	lb.	.52	.54
Stalite	lb.	.52	.54
S	lb.	.52	.54
White	lb.	1.45	1.55
Akroflex C	lb.	.77	.79
CD	lb.	.72	.74
Albasan	lb.	.69	.73
Allied AA-1144	lb.	.23	.24
AA-1177	lb.	.155	.165
Aminox	lb.	.52	.57
Antioxidant 425	lb.	2.50	
2246	lb.	1.55	1.58
Antisol	lb.	.23	.24
Antisun	lb.	.15	.175
Antox	lb.	.52	.54
Aranox	lb.	3.25	
Betanox Special	lb.	.80	.85
B-L-E, -25	lb.	.52	.57
Burgess Antisun Wax	lb.	.185	
B-X-A	lb.	.52	.57
Copper Inhibiter X-872-L	lb.	2.01	
D-B-P-C	lb.	.91	1.16
Flectol H	lb.	.52	.59
Flexamine	lb.	.72	.77
Heliozone	lb.	.26	.27
Ionol	lb.	.91	1.40
NBC	lb.	1.55	
Neozone A	lb.	.56	.58
D	lb.	.52	.54
Octamine	lb.	.52	.57
PDA-10	lb.	.46	.48
Perflectol	lb.	.61	.68
Polygard	lb.	.52	.57
Protector	lb.	.26	.31
Rio Resin	lb.	.60	.62
Santoflex 35	lb.	.72	.79
75	lb.	.92	.99
AW	lb.	.78	.85
B	lb.	.52	.59
BX	lb.	.63	.70
DD	lb.	.52	.59
Santovar A	lb.	1.50	1.57
Santowhite Crystals, Powder	lb.	1.60	1.67
L	lb.	.52	.59
MK	lb.	1.29	1.36
Sharples Wax	lb.	.23	.28
Stabilite	lb.	.55	.59
Alba	lb.	.72	.79
L	lb.	.60	.64
White	lb.	.52	.60
Powder	lb.	.41	.47
Styphen I	lb.	.51	.55
Sunolite #100	lb.	.21	.23
#127	lb.	.17	.19
Sunproof -713	lb.	.25	.30
Improved	lb.	.25	.30
Jr.	lb.	.20	.25
Thermoflex A	lb.	.98	1.00
Tonox	lb.	.52	.57
Tysonite	lb.	.24	.2475
Velvapex 51-250	lb.	.40	
V-G-B	lb.	.70	.75
Wing-Stay S	lb.	.52	.61
Zenite	lb.	.48	.50

Antiseptics

Copper naphthenate, 6-8%	lb.	.235	
Pentachlorophenol	lb.	.21	.29
Resorcinol, technical	lb.	.775	.785
Zinc naphthenate, 8-10%	lb.	.245	.30

Blowing Agents

Ammonium bicarbonate	lb.	.065	.085
Carbonate	lb.	.23	.24
Blowing Agent CP-975	lb.	.35	

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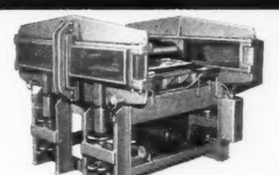

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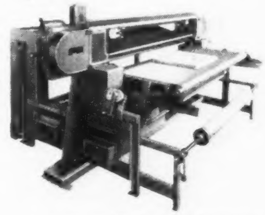

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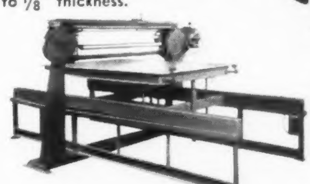

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Celogen	lb.	$1.95	
50-C	lb.	1.01 /	$1.07
Sodium bicarbonate	100 lbs.	2.70 /	3.30
Carbonate, tech	100 lbs.	1.35 /	5.52
Sponge Paste	lb.	.20	
Unicel	lb.	.90	
ND	lb.	.76	
S	lb.	.20	

Bonding Agents

Braze	gal.	6.00 /	9.00
Cover cement	gal.	2.50 /	4.00
Flocking Adhesive RFA17, RFA22, RFA25	lb.	.50	
G-E Silicone Paste SS-15	lb.	4.52 /	5.10
SS-64	lb.	3.65 /	6.75
-67 Primer	lb.	7.50 /	12.50
Gen-Tac Latex	lb.	.75 /	.855
Kalabond Adhesive	gal.	6.50 /	16.00
Tie Cement	gal.	2.00 /	5.60
MDI	lb.	4.00 /	6.00
-50	lb.	2.00 /	3.00
Thixons	gal.	1.48 /	12.00
Ty Ply BN, Q, S UP, 3640	gal.	6.75 /	8.00
RC	gal.	3.75 /	5.00

Brake Lining Saturants

BRT 3	lb.	.018 /	.0265
Resinex L-S	lb.	.0225/	.03

Carbon Blacks‡

Conductive Channel—CC

Continental R-40	lb.	.23 /	.30
Kosmos/Dixie BB	lb.	.23 /	.30
Spheron C	lb.	.14 /	.185
Voltex	lb.	.18 /	.315

Easy Processing Channel—EPC

Continental AA	lb.	.074 /	.1225
Kosmobile 77/Dixiedensed 77	lb.	.074 /	.1225
Micronex W-6	lb.	.074 /	.1225
Spheron #9	lb.	.074 /	.1225
Texas E	lb.	.074 /	.1225
Witco #12	lb.	.074 /	.1225
Wyex	lb.	.074 /	.12

Hard Processing Channel—HPC

Continental F	lb.	.074 /	.1225
HX	lb.	.074 /	.12
Kosmobile S/Dixiedensed S	lb.	.074 /	.1225
Micronex Mk. II	lb.	.074 /	.1225
Spheron #4	lb.	.074 /	.1225
Witco #6	lb.	.074 /	.1225

Medium Processing Channel—MPC

Arrow TX	lb.	.074 /	.12
Continental A	lb.	.074 /	.1225
Kosmobile S-66/Dixiedensed S-66	lb.	.074 /	.1225
Micronex Standard	lb.	.074 /	.1225
Spheron #6	lb.	.074 /	.1225
Texas 109	lb.	.079 /	.1275
Texas M	lb.	.074 /	.1225
Witco #1	lb.	.074 /	.1225

Conductive Furnace—CF

Aromex 115	lb.	.089 /	.129
Vulcan C	lb.	.105 /	.15
SC	lb.	.18 /	.223

Fast Extruding Furnace—FEF

Arovel	lb.	.06 /	.10
Continex FEF	lb.	.06 /	.10
Kosmos 50/Dixie 50	lb.	.06 /	.10
Statex M	lb.	.06 /	.10
Sterling SO	lb.	.06 /	.10

Fine Furnace—FF

Statex B	lb.	.065 /	.105
Sterling 99	lb.	.065 /	.105

High Abrasion Furnace—HAF

Aromex	lb.	.079 /	.119
Continex HAF	lb.	.079 /	.125
Kosmos 60/Dixie 60	lb.	.079 /	.1175
Philblack O	lb.	.079 /	.119
Statex R	lb.	.079 /	.125
Vulcan #3	lb.	.079 /	.125

Intermediate Super Abrasion Furnace—ISAF

Aromex 125	lb.	.10 /	.14
Kosmos 70/Dixie 70	lb.	.10 /	.145
Philblack I	lb.	.10 /	.145
Statex 125	lb.	.10 /	.145
Vulcan 6	lb.	.10 /	.145

Medium Abrasion Furnace—MAF

Philblack A	lb.	.06 /	.10

Super Abrasion Furnace—SAF

Philblack E	lb.	.125 /	.165
Vulcan 9	lb.	.125	.168

General-Purpose Furnace—GPF

Sterling V	lb.	.05 /	.09
V Non-staining	lb.	.05 /	.09

‡ At the request of the suppliers, the lowest prices shown for carbon blacks are for carloads in bags. Prices for hopper carloads are lower.

High Modulus Furnace—HMF

Continex HMF	lb.	$0.055 /	$0.095
Kosmos 40/Dixie 40	lb.	.055 /	.095
Modulex	lb.	.055 /	.095
Statex 93	lb.	.055 /	.095
930	lb.	.047 /	.087
Sterling L, LL	lb.	.055 /	.095

Semi-Reinforcing Furnace—SRF

Continex SRF	lb.	.045 /	.085
Essex	lb.	.045 /	.085
Furnex	lb.	.045 /	.085
Gastex	lb.	.05 /	.09
Kosmos 20/Dixie 20	lb.	.045 /	.085
Pelletex, NS	lb.	.045 /	.085
Sterling NS, S	lb.	.045 /	.085
R	lb.	.05 /	.09

Fine Thermal—FT

P-33	lb.	.055	
Sterling FT	lb.	.055	

Medium Thermal—MT

Sterling MT	lb.	.04	
Non-staining	lb.	.05	
Thermax	lb.	.035	
Stainless	lb.	.045	

Colors

Black

Iron oxides, comml.	lb.	.1275/	.13
BK—Lansco	lb.	.1275/	.13
Williams	lb.	.1275/	.13
Lansco synthetic	lb.	.10	
Mapico	lb.	.1275/	.13
Lampblack, comml.	lb.	.16 /	.45
Superjet	lb.	.0825/	.1175
Permanent Blue	lb.	.80 /	1.05
Stan-Tone	lb.	.45 /	1.20
Vansul masterbatch	lb.	.60 /	.65
Paste	lb.	.14 /	.15

Blue

Du Pont	lb.	1.77 /	4.55
Filo	lb.	.28	
Heveatex pastes	lb.	.80 /	1.45
Lansco ultramarines	lb.	.25 /	.28
Monsanto Blue 7	lb.	1.55	
11	lb.	3.45	
DPB-283	lb.	1.93	
S-11	lb.	2.05	
Permanent Blue	lb.	.80 /	1.05
Stan-Tone	lb.	1.55 /	1.60
Vansul masterbatch	lb.	.90 /	2.70

Brown

Filo	lb.	.13	
Iron oxides, comml.	lb.	.1375/	.14
Lansco synthetic	lb.	.125	
Mapico Brown	lb.	.1375/	.14
Brown 422	lb.	.14	
Sienna, burnt, comml.	lb.	.0425/	.155
Williams	lb.	.11 /	.1725
Raw, comml.	lb.	.045 /	.1325
Williams	lb.	.08 /	.1725
Umber, burnt, comml.	lb.	.06 /	.07
Williams	lb.	.0675/	.08
Raw, comml.	lb.	.0625/	.07
Williams	lb.	.07 /	.0825
Williams			
Pure brown	lb.	.1375/	.14
Vandyke	lb.	.12	
Mapico Tan 20	lb.	.2025/	.205
Tan 15	lb.	.205	
Metallic brown	lb.	04 /	.05
Vansul masterbatch	lb.	2.10 /	2.20

Green

Chrome	lb.	.19 /	.50
Chrome oxide	lb.	.3925/	1.10
G-4099, -6099	lb.	.3925/	.3975
GH-9869	lb.	1.00 /	1.15
9976	lb.	1.10 /	1.25
Green	lb.	.80 /	2.40
Du Pont	lb.	1.97 /	2.80
Filo	lb.	.40	
Heveatex pastes	lb.	.95 /	1.85
Lansco Toner	lb.	1.35	
Monsanto Green 3	lb.	2.75	
14	lb.	1.45	
17	lb.	3.95	
71205	lb.	1.35	
DGP	lb.	2.03	
S-17	lb.	2.25	
Stan-Tone	lb.	1.75 /	4.60
Vansul masterbatch	lb.	2.00 /	2.60

Orange

Du Pont	lb.	2.75	
Monsanto Orange 68187	lb.	2.90	
Stan-Tone	lb.	.70 /	3.35
Vansul masterbatch	lb.	2.00 /	2.60

Red

Antimony trisulfide	lb.	.27 /	.30
R. M. P. No. 3	lb.	.72	
Sulfur Free	lb.	.78	
Cadmium red lithopone	lb.	1.64 /	2.05
Cadmolith	lb.	1.72 /	2.20
Cyanamid	lb.	.85	
Du Pont	lb.	1.47 /	1.80
Filo	lb.	.11	
Indian Red	lb.	.1275	
Iron oxide, comml.	lb.	$0.06 /	$0.13
Lansco synthetic	lb.	.1175	
Mapico	lb.	.1275/	.13
Recco	lb.	.12	
Williams Red	lb.	.1275/	.15
Monsanto Red 7	lb.	1.55	
41	lb.	4.40	
3501	lb.	1.15	
4004	lb.	1.50	
69191	lb.	3.38	
Autumn	lb.	1.10	
PRP-285	lb.	1.27	
S-44	lb.	1.28	
Maroon 113	lb.	1.50	
61148	lb.	1.75	
Rub-Er-Red	lb.	.0975	
Stan-Tone	lb.	.85	4.05
Tuscan	lb.	.15 /	.46
Vansul masterbatch	lb.	.95 /	3.30
Venetian	lb.	.035 /	.0625

White

Antimony oxide	lb.	.29 /	.305
Burgess Iceberg	ton	50.00 /	80.00
Cryptone BT	lb.	.10 /	.11
Permolith	lb.	.075 /	.085
Titanium pigments			
Rayox LW	lb.	.195 /	.205
R-110	lb.	.215 /	.225
Ti-Cal	lb.	.075 /	.0825
Ti-Pure	lb.	.195 /	.225
Titanox A, AA, A-168	lb.	.21 /	.22
C-50	lb.	.1225/	.1275
RA, -10, -50	lb.	.23 /	.24
RC	lb.	.0825/	.0875
-HT, -HTX	lb.	.08 /	.085
Unitane	lb.	.225 /	.255
Zopaque Anatase	lb.	.225 /	.235
Rutile	lb.	.245 /	.255
Zinc oxide, comml.	lb.	.135 /	.1775
Azo ZZZ-11, -44, -55	lb.	.135 /	.155
20% leaded	lb.	.1395/	.1595
35% leaded	lb.	.1425/	.1625
50% leaded	lb.	.14625/	.16625
Eagle AAA, lead free	lb.	.135 /	.145
5% leaded	lb.	.135 /	.145
35% leaded	lb.	.1425/	.1525
50% leaded	lb.	.14625/	.15625
Florence Green Seal	lb.	.1525/	.1625
Red Seal	lb.	.1475/	.1575
White Seal	lb.	.1575/	.1675
Horsehead XX-4, -78	lb.	.135 /	.145
Kadox -15, -17, -22	lb.	.135 /	.145
-25	lb.	.1575/	.1675
Lehigh, 35% leaded	lb.	.14 /	.15
50% leaded	lb.	.14⅛/	.15⅛
Protox-166, -167	lb.	.135 /	.145
St. Joe, lead free	lb.	.135 /	.145
Zinc sulfide, comml.	lb.	.253 /	.263
Cryptone ZS	lb.	.253 /	.263

Yellow

Cadmium yellow lithopone	lb.	1.15	
Cadmolith	lb.	1.12 /	1.20
Du Pont	lb.	1.80 /	2.15
Filo	lb.	.10	
Iron oxide, comml.	lb.	.0525/	.1075
Lansco synthetic	lb.	.1075	
Mapico	lb.	.105 /	.1075
Williams	lb.	.105	.1125
Monsanto Yellow 14	lb.	1.91	
10010	lb.	1.91	
BYP-282	lb.	1.21	
GA	lb.	2.45	
S-10010	lb.	1.17	
Stan-Tone	lb.	1.00 /	1.55
Vansul masterbatch	lb.	.95 /	1.95
Williams Ocher	lb.	.0525/	.055

Dusting Agents

Diatomaceous silica	ton	32.00 /	48.00
Extrud-o-Lube, conc	gal.	1.54 /	1.69
Glycerized Liquid Lubricant, concentrated	gal.	1.48 /	1.63
Latex-Lube GR	lb.	.20	
Pigmented	lb.	.1825	
R-66	lb.	.165	
Liqui-Lube	lb.	.1625	
N. T.	lb.	.1675	
Liquizinc No. 305	lb.	.30 /	.35
Lubrex	lb.	.25 /	.30
Mica Concord	lb.	.075 /	.0825
Mineralite	ton	45.00	
Pyrax A	ton	13.50	
W. A.	ton	16.00	
Talc, comml.	ton	14.00 /	38.50
EM	ton	11.00 /	63.00
LS Silver	ton	29.25	
Nytals	ton	25.00 /	36.00
Sierra Sagger 7	ton	34.00	
Sierra white IR	ton	19.75	
III	ton	20.75	
Vanfre	gal.	2.00 /	2.50

Extenders

BRS 700	lb.	.02 /	.0285
BRT 7	lb.	.03 /	.031
Cumar Resins	lb.	.065 /	.17
Dielex B	lb.	.06	
Factice, Amberex	lb.	.29 /	.36
Brown	lb.	.1425/	.268
Neophax	lb.	.157 /	.268
White	lb.	.144 /	.285
G.B. Asphaltenes	lb.	.06 /	.065

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Millex, W	lb.	$0.07		
Mineral Rubbers				
Black Diamond	ton	38.00	/	$40.00
Hard Hydrocarbon	ton	46.50	/	48.50
Hydrocarbon MR	ton	45.00	/	55.00
Parmr	ton	21.00	/	29.00
T-MR Granulated	ton	47.50	/	50.00
Nuba No. 1, 2	lb.	.0575	/	.0625
3X	lb.	.0775	/	.0825
OPD-101	lb.	.26		
Rubber substitute, brown	lb.	.1835	/	.2012
Car-Bel-Ex A	lb.	.14		
Car-Bel-Lite	lb.	.35		
Extender 600	lb.	.1765		
White	lb.	.148	/	.256
Stan-Shells	ton	35.00	/	73.00
Synthetic 100	lb.	.41		
Vistanex	lb.	.45	/	.475

Fillers, Inert

Agrashell flour	ton	50.00	/	74.00
Barytes, floated, white	ton	41.60	/	60.10
Off-color, domestic	ton	25.00		
No. 1	ton	41.35	/	60.10
2	ton	39.35	/	58.00
Sparmite	ton	75.00	/	80.00
Blanc fixe	ton	100.00	/	165.00
Burgess Iceberg	ton	50.00	/	80.00
Pigment #20	ton	35.00	/	60.00
#30	ton	37.00	/	60.00
HC-75	ton	12.00	/	30.00
HC-80	ton	14.00	/	32.00
WP #1	ton	11.00	/	16.00
Cary #200	ton	30.00	/	55.00
Citrus seed meal	lb.	.04		
Oil	lb.	.15		
Clays				
Aiken	ton	14.00		
Albacar	ton	50.00	/	55.00
Aluminum Flake	ton	20.00	/	60.00
#5	ton	23.50	/	30.00
Champion	ton	14.00		
Crown	ton	14.00	/	33.00
Dixie	ton	14.00		
Franklin	ton	13.50	/	35.25
GK Soft Clay	ton	11.00		
Hi-White R	ton	13.50		
Hydratex R	ton	28.00		
Kaolloid	ton	10.50		
Laminar	ton	30.00		
Paragon	ton	13.50	/	31.50
McNamee	ton	13.50		
RX-43	ton	33.00		
Recco	ton	14.00		
Sno-Brite	ton	12.50		
Stan-Clay	ton	28.00		
Stellar-R	ton	50.00		
Suprex	ton	14.00	/	32.00
Swanee	ton	12.50		
Windsor	ton	14.00	/	30.00
Diatomaceous silica	ton	$32.00	/	$48.00
Flocks				
Cotton, dark	lb.	.095	/	.135
Dyed	lb.	.55	/	.60
White	lb.	.13	/	.33
Fabrifil X-24-G	lb.	.135		
X-24-W	lb.	.235		
Filfloc 6000	lb.	.33		
F-40-900	lb.	.135		
HSC #35 Silicone Emulsion	lb.	1.36	/	3.50
Kalite	ton	50.00	/	65.00
Lithopone, comml	lb.	.075	/	.085
Albalith	lb.	.075	/	.085
Astrolith	lb.	.06¾	/	.0675
Eagle	lb.	.0725	/	.075
Sunolith	lb.	.075	/	.0825
Mica Concord	lb.	.075	/	.0825
Millical	ton	35.00	/	50.00
Mineralite	ton	40.00	/	60.00
Non-Fer-Al	ton	30.00	/	45.00
Purecal	ton	56.75	/	71.75
Pyrax A	ton	13.50		
W. A	ton	16.00		
Sawdust	ton	14.00	/	33.00
Stan-White	ton	8.50	/	9.45
Super-White Silica	ton	23.00	/	43.00
Suspenso	ton	33.00	/	48.00
Ti-Cal	lb.	.0675		
Valron estersil	lb.	1.00		
Whiting, limestone				
Atomite	ton	30.00		
Calcite	ton	21.50		
Keystone	ton	16.00		
Omya	ton	30.00		
Paxinosa	ton	10.00	/	18.00
Snowflake	ton	17.00	/	18.00
Stonelite	ton	9.00		
Witco	ton	8.50		
York	ton	9.50		

Finishes

Apex Bright Finish #5200-E	lb.	.25		
Rubber Finish	gal.	2.50		
Black-out	gal.	4.50	/	8.00
Flocks				
Rayon, colored	lb.	.90	/	1.50
White	lb.	.75	/	1.25
Also see Flocks, under Fillers, Inert				
Rubber lacquer, clear	gal.	1.00	/	2.00
Shellacs, Angelo	lb.	.485	/	.7325
Vac Dry	lb.	.485	/	.57
Talc (*See Talc, under Dusting Agents*)				
Unidip	lb.	.15	/	.20
Wax, Bees	lb.	.61	/	.75
Carnauba	lb	.63	/	1.07
Montan	lb.	.135	/	.32
No. 118, colors	gal.	.86	/	1.41
Neutral	gal.	.76	/	1.31
Van Wax	gal.	1.45	/	1.50

Latex Compounding Ingredients

Acintol D, DLR	lb.	$0.06	/	$0.075
FA #1	lb.	.065	/	.08
#2	lb.	.075	/	.09
Accelerator 552	lb.	2.25		
J-117, -302	lb.	1.00	/	1.15
-144	lb.	.15	/	.30
-307	lb.	1.10	/	1.25
-311	lb.	.60	/	.75
Aerosol, dry types	lb.	.39	/	1.20
Liquid types	lb.	.40	/	.72
Alcogum AN-6	lb.	.05		
AN-10	lb.	.085		
Alrosol	lb.	.41		
Alrowet D-75	lb.	.63		
Amberex solutions	lb.	.1675	/	.18
Antifoam J-114	lb.	3.25	/	3.45
P-242	lb.	.24	/	.35
Antioxidant J-137, -140	lb.	.55	/	.70
-139, -293	lb.	1.45	/	1.60
-182	lb.	2.00	/	2.15
-186	lb.	1.40	/	1.55
2246	lb.	1.65	/	1.68
Anti-Webbing Agent J-183	lb.	.75	/	.90
-297	lb.	.27	/	.40
Aquablak B	lb.	.0925	/	.0975
G	lb.	.105	/	.11
K	lb.	.1075	/	.1125
M	lb.	.085	/	.09
Aquarex D	lb.	.78		
G	lb.	.21		
L, ME	lb.	.94		
MDL	lb.	.33		
NS	lb.	.60		
SMO	lb.	.50		
WAQ	lb.	.23		
Areskap 50	lb.	.30	/	.38
100, dry	lb.	.60	/	.72
Aresket 240	lb.	.30	/	.38
300, dry	lb.	.60	/	.72
Aresklene 375	lb.	.42	/	.57
Ben-A-Gels	lb.	.98	/	1.40
Bentone 18, 18C	lb.	.45		
34	lb.	.60		
Casein	lb.	.22		
Cellosize WP-09, -3, -300	lb.	1.36	/	1.60
CW -12	lb.	.85		
37	lb.	.70		
Defoama W-1701	lb.	.125		
Defoamer 115a	lb.	.50		
Dispersing Agents				
Blancol	lb.	.1525	/	.26
N	lb.	.155	/	.26
Darvan Nos. 1, 2, 3	lb.	.22	/	.30
Daxad 11, 21, 23, 27	lb.	.08	/	.30
Dispersaid H7A	lb.	.58		
1159	lb.	.43		
Emulphor ON-870	lb.	.50	/	.70
Igepal CO-630	lb.	.2875	/	.47
Igepon T-73	lb.	.285	/	.495
T-77	lb.	.45	/	.69
Indulins	lb.	.06	/	.08
Kreelons	lb.	.132	/	.155
Laurelton Oil	lb.	.18		
Leonil SA	lb.	.52	/	.65
Lomar PW	lb.	.18		
Marasperse CB	lb.	.1225	/	.1425
N	lb.	.095	/	.105
Modicols	lb.	.17	/	.58
Nekal BA-75	lb.	.395	/	.54
BX-76	lb.	.63	/	.75
Pluronics	lb.	.335	/	.40
Polyfons	lb.	.08	/	.09
Sorapon SF-78	lb.	.28	/	.40
Tergitol NPX	lb.	.275	/	.3074
TMN	lb.	.2875	/	.32
7	lb.	.4125	/	.44
Trenamine	lb.	.15		
Triton R-100	lb.	.12	/	.25
X-100, -102, -114	lb.	.255	/	.36
Dispersions				
AgeRite Alba	lb.	3.00		
Powder, Resin D	lb.	.80		
White	lb.	1.80		
Altax	lb.	.75		
Black No. 25	lb.	.22		
Black Shield Nos. 2, 6	lb.	.08		
3	lb.	.095		
4-35	lb.	.09		
5	lb.	.093		
7-F, 8	lb.	.165		
55	lb.	.18		
Iron oxide, 60%	lb.	.40		
No. 305 Liquizinc	lb.	.30	/	.35
L.S.W.	lb.	1.50		
P-33	lb.	.35		
Rayox	lb.	.45		
Rotax	lb.	.75		
Sulfur	lb.	.12	/	.30
No. 2	lb.	.14	/	.16
Telloy	lb.	3.00		
Tuads, Methyl	lb.	1.60		
Vulcanizing				
C group	lb.	.40	/	1.30
G group	lb.	.45	/	.90
N group	lb.	.40	/	1.00
Zetax	lb.	.75		
Zimates, Butyl	lb.	1.30		
Ethyl, Methyl	lb.	1.35		
Zinc oxide	lb.	.40		
Emulsions				
AgeRite Stalite	lb.	.75		
Habuco Resin Nos. 502, 515, 523	lb.	.195	/	.20
503	lb.	.22	/	.225
504, 526	lb.	.19	/	.195
517	lb.	.175	/	.18
524	lb.	.155	/	.16
Resin A-2	lb.	$0.16	/	$0.25
P-370	lb.	.175	/	.25
X-210	lb.	.12	/	.22
Freeze-Stabilizer 322	lb.	.40		
12116C	lb.	.52		
Gelling Agent P-397	lb.	.34	/	.37
Igepon T-43	lb.	.145	/	.35
T-51	lb.	.125	/	.285
-73	lb.	.285	/	.495
Indulins	lb.	.06	/	.08
Ludox	lb.	.1675	/	.1925
Marmix	lb.	.41	/	.48
Merac	lb.	.75	/	1.05
Micronex, colloidal	lb.	.06	/	.07
Monsanto Blue 4685 WD	lb.	1.60		
Green 4884 WD	lb.	1.80		
Red 127	lb.	1.25		
OPD-101	lb.	.16	/	.26
Pliolite Latex 150, 190	lb.	.32	/	.41
170	lb.	.37	/	.46
Polyvinyl methyl ether	lb.	.25	/	.45
Resin V	lb.	.13		
Roelgel 100C	lb.	.46		
Santomerse D	lb.	.44	/	.65
S	lb.	.13	/	.25
Sellogen Gel	lb.	.1275		
Sequestrene AA	lb.	.905	/	.975
30A	lb.	.245	/	.265
ST	lb.	.585	/	.615
Setsit #5	lb.	.75	/	1.05
Stablex A	lb.	.80	/	1.10
B, G	lb.	.50	/	.95
K	lb.	.27	/	.35
P	lb.	.35	/	.50
T	lb.	.14	/	.22
Webnix	lb.	1.50	/	2.50

Mold Lubricants

Acintol D	lb.	.06	/	.075
A-C Polyethylene	lb.	.30	/	.37
Akro Gel	lb.	.165		
Alipal CO-433	lb.	.25	/	.45
CO-436	lb.	.22	/	.41
Aquarex Compounds	lb.	.21	/	.94
Carbowax 200, 300, 400	lb.	.22	/	.25
1500	lb.	.255	/	.2825
4000	lb.	.31	/	.32
6000	lb.	.35	/	.36
Colite Concentrate	gal.	.90	/	1.15
D-Tak Dip #10	gal.	1.50		
ELA	lb.	.82		
DC Mold Release Fluid	lb.	3.39	/	4.75
Emulsion Nos. 35, 35A, 35B, 36	lb.	1.36	/	2.50
DC7	lb.	5.13	/	6.50
8	lb.	1.36	/	1.80
Glycerized Liquid Lubricant, concentrated	gal.	1.48	/	1.63
Igepals	lb.	.2875	/	.47
Igepon AP-78	lb.	.44	/	.68
T-43	lb.	.145	/	.35
T-51	lb.	.125	/	.285
T-73	lb.	.285	/	.495
Lubrex	lb.	.25	/	.30
Lubri-Flo	gal.	10.00	/	12.05
Lustermold	lb.	.41		
Mold Paste	lb.	.25		
Monopole Oil	lb.	.16		
Monten Wax	lb.	.57		
Para Lube	lb.	.046	/	.048
Pluronics	lb.	.335	/	.44
Polyglycol E series	lb.	.29	/	.42
Rubber-Glo	gal.	.94	/	.97
Soap, Hawkeye	lb.	1.35	/	1.45
Purity	lb.	.155	/	.165
Sodium stearate	lb.	0.40		
Stoner's 700 series	gal.	1.20	/	1.25
800 series	gal.	1.26	/	1.70
900 Series	gal.	1.55	/	2.55
A Series	gal.	1.80	/	4.50
Ucon 50-HB Series	lb.	.25	/	.375
Ulco	lb.	.12	/	.23
Vanfre	gal.	2.50	/	3.00

Odorants

Alamasks	lb.	.75	/	6.50
Coumarin	lb.	2.95	/	3.55
Curodex 19	lb.	4.75	/	5.05
188	lb.	5.75		
198	lb.	6.75		
Ethavan	lb.	6.75	/	7.35
Latex Perfume #7	lb.	4.00		
Neutroleum Gamma	lb.	3.60		
Rubber Perfume #10	lb.	2.60		
Vanillin, Monsanto	lb.	3.00	/	3.15

Plasticizers and Softeners

Acintol R	lb.	.065	/	.07
Adipol 2EH, 10A	lb.	.435	/	.465
BCA	lb.	.45	/	.475
ODY	lb.	.48	/	.51
Aro Lene #1980	lb.	.10	/	.12
Baker AA Oil	lb.	.195	/	.24
Crystal O Oil	lb.	.21	/	.255
Processed oils	lb.	.215	/	.235
Bardol, 639	lb.	.215	/	.235
B	lb.	.0625	/	.065
Benzoflex 2-45	lb.	.26	/	.29
9-88	lb.	.27	/	.30
Bondogen	lb.	.55	/	.60
BRC 20	lb.	.15	/	.175
22	lb.	.025	/	.0275
30	lb.	.0125	/	.021
521	lb.	.019	/	.02
BRH 2	lb.	.0213	/	.0351
BRS 700	lb.	.02	/	.0285

$0.25
.25
.22

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.495
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1.05
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ORLD

BRT 7	lb.	$0.03 /	$0.031
BRV	lb.	.0475/	.0565
Bunarex Liquid	lb.	.0425/	.0555
Resins	lb.	.065 /	.1225
Bunnatol G, S	lb.	.40 /	.505
Butac	lb.	.125 /	.135
Butyl stearate, comml	lb.	.24 /	.27
Binney & Smith	lb.	.23 /	.26
Hardesty	lb.	.23 /	.26
BzDC	lb.	.40 /	.41
Cabol 100	lb.	.02 /	.06
Califlux 510, 550	lb.	.025 /	.0325
G. P.	lb.	.0125/	.02
R-100	lb.	.045 /	.0525
TT	lb.	.017 /	.0245
Capryl alcohol, comml	lb.	.165 /	.20
Binney & Smith	lb.	.18 /	.28
Hardesty	lb.	.18 /	.28
Chlorowax 40	lb.	.145 /	.225
70	lb.	.18 /	.24
-S	lb.	.21 /	.27
Contogums	lb.	.0875/	.111
Cumar Resins	lb.	.065 /	.17
DBM (di butyl-m-cresol)			
Darex	lb.	.32 /	.3475
DBP (di butyl phthalate),			
comml	lb.	.30 /	.33
Darex	lb.	.30 /	.33
Hatco	lb.	.30 /	.33
Monsanto	lb.	.30 /	.33
Naugatuck	lb.	.30 /	.33
Rubber Corp. of America	lb.	.30 /	.44
Sherwin-Williams	lb.	.30 /	.33
DBS (di butyl sebacate),			
comml	lb.	.66 /	.69
Hatco	lb.	.66 /	.685
Monoplex	lb.	.66 /	.675
Naugatuck	lb.	.665 /	.69
DCP (di capryl phthalate),			
comml	lb.	.295 /	.325
Hatco	lb.	.295 /	.325
Monoplex	lb.	.30 /	.315
DDA (di decyl adipate)			
Cabflex	lb.	.425 /	.455
DDP (di decyl phthalate)			
Cabflex	lb.	.305 /	.335
Hatco	lb.	.305 /	.435
Defoamer X-3	lb.	.355	
DIBA (di iso butyl adipate)			
Cabflex	lb.	.4325/	.4625
Darex	lb.	.4325/	.4625
DIDA (di iso decyl adipate)			
Monsanto	lb.	.435 /	.465
DIDP (di iso decyl phthalate)			
Darex	lb.	.32 /	.35
Monsanto	lb.	.32 /	.35
Dielex B	lb.	.06	
Diethylene glycol, comml	lb.	.1475/	.1750
Wyandotte	lb.	.15 /	.165
Dinopol IDO	lb.	.305 /	.335
DIOA (di iso octyl adipate)			
Cabflex	lb.	.425 /	.455
Naugatuck	lb.	.435 /	.465
Rubber Corp. of America	lb.	.425 /	.56
DIOP (di iso octyl phthalate).			
comml	lb.	.305 /	.335
Cabflex	lb.	.305 /	.335
Darex	lb.	.32 /	.35
Hatco	lb.	.305 /	.335
Monsanto	lb.	.32 /	.35
Naugatuck	lb.	.305 /	.335
Ohio-Apex	lb.	.305 /	.335
Rubber Corp. of America	lb.	.305 /	.45
Sherwin-Williams	lb.	.32 /	.34
DIOS (di iso octyl sebacate),			
comml	lb.	.61 /	.64
Rubber Corp. of America	lb.	.61 /	.84
DIOZ (di iso octyl azelate)			
Cabflex	lb.	.48 /	.5075
Dipolymer Oil	gal.	.33 /	.38
Dispersing Oil No. 10	lb.	.06 /	.0625
DNODP (di-n-octyl-n-decyl phthalate)			
Monsanto	lb.	.335 /	.365
DOA (di octyl adipate),			
comml	lb.	.425 /	.455
Cabflex	lb.	.425 /	.455
Hatco	lb.	.435 /	.465
Monsanto	lb.	.435 /	.465
Naugatuck	lb.	.435 /	.465
Rubber Corp. of America	lb.	.425 /	.56
DOP (di octyl phthalate),			
comml	lb.	.305 /	.335
Cabflex	lb.	.305 /	.335
Darex	lb.	.32 /	.35
Hatco	lb.	.305 /	.335
Monsanto	lb.	.32 /	.35
Naugatuck	lb.	.305 /	.335
Ohio-Apex	lb.	.305 /	.335
Rubber Corp. of America	lb.	.305 /	.45
Sherwin-Williams	lb.	.32 /	.34
DOS (di octyl sebacate),			
comml	lb.	.61 /	.64
Hatco	lb.	.61 /	.635
Monoplex	lb.	.61 /	.635
Naugatuck	lb.	.615 /	.64
Rubber Corp. of America	lb.	.61 /	.84
Drapex 3.2	lb.	.40	.45
Dutch Boy NL-A10 (DBP)	lb.	.30	.33
-A20 (DOP), A30 (DIOP)	lb.	.305	.335
-A54	lb.	.295	.325
-C20 (DOS)	lb.	.61	.63
-F21	lb.	.395 /	.425
-F31	lb.	.44 /	.47
-F41	lb.	.48 /	.51
Dutrex 6	lb.	.025 /	.035
Emulphor EL-719	lb.	.52 /	.73
Ethox	lb.	.43 /	.455
Ethylene glycol, comml	lb.	.13 /	.1575

Wyandotte	lb.	$0.1325/	$0.1425
Flexol 3 GH	lb.	.44 /	.46
3 GO	lb.	.53 /	.55
4 GO	lb.	.325 /	.355
426	lb.	.27 /	.30
TOF, A-26	lb.	.435 /	.465
Fortex	lb.	.125 /	.145
G. B. Asphaltic Flux	gal.	.08 /	.14
Naphthenic Neutrals	gal.	.11 /	.18
Process Oil			
Light	lb.	.025 /	.0325
Medium	lb.	.035 /	.0425
Galex W-100	lb.	.155 /	.18
W-100 D	lb.	.1525/	.1775
Gilsowax B	lb.	.09 /	.11
Good-rite GP-233	lb.	.435 /	.58
GP-261	lb.	.305 /	.455
Harchemex	lb.	.25 /	.34
Harflex 10	lb.	1.25 /	1.335
40	lb.	.66 /	.745
50, 80	lb.	.61 /	.695
60	lb.	.62 /	.705
90	lb.	.88 /	.965
120, 150	lb.	.32 /	.35
140, 160, 180	lb.	.30 /	.33
220	lb.	.435 /	.465
260	lb.	.42 /	.45
280	lb.	.43 /	.46
500	lb.	.315 /	.345
HB-20	lb.	.15 /	.17
-40	lb.	.22 /	.24
Heavy Resin Oil	lb.	.0225/	.0375
HSC-13	lb.	.27 /	.30
Indoil Compound 51-S	lb.	1.00 /	1.10
Indonex	gal.	.11 /	.19
Kapsol	lb.	.3225/	.3525
Kenflex A, L	lb.	.26 /	.27
B	lb.	.23 /	.24
N	lb.	.18 /	.19
Kessoflex 103	lb.	.405	
105	lb.	.3325	
106	lb.	.38	
107	lb.	.525	
110	lb.	.24	
111	lb.	.28	
KP-23	lb.	.29 /	.32
-90	lb.	.45 /	.48
-140	lb.	.46 /	.485
-201	lb.	.5825/	.5925
-220	lb.	.31 /	.34
-555	lb.	.45 /	.475
Kronisol	lb.	.33 /	.355
Kronitex AA, I	lb.	.33 /	.36
Marvinol plasticizers	lb.	.28 /	.8825
Methox	lb.	.385 /	.41
Monoplex S-38	lb.	.215 /	.24
S-71	lb.	.45 /	.475
Morflex	lb.	.25 /	.65
Neoprene Peptizer P-12	lb.	1.05	
Nevillac	lb.	.39 /	.85
Neville R Resins	lb.	.13 /	.35
Nevinol	lb.	.20	
No. 1-D heavy oil	lb.	.065	
ODA (octyl decyl adipate)			
Cabflex	lb.	.425 /	.455
ODP (octyl decyl phthalate)			
Cabflex	lb.	.305 /	.335
Hatco	lb.	.305 /	.335
Rubber Corp. of America	lb.	.305 /	.45
Ohopex R-9	lb.	.3525/	.3775
Q-10	lb.	.295 /	.325
Orthonitro benzophenol,			
comml	lb.	.13 /	.15
Monsanto	lb.	.13 /	.15
Palmalene	lb.	.15	
Panaflex BN-1	lb.	.185 /	.225
Para Flux, regular	gal.	.10 /	.2125
No. 2016	gal.	.165 /	.24
2332	gal.	.11	
4205	lb.	.1075/	.2125
Para Lube	lb.	.046 /	.048
Resins	lb.	.04 /	.045
Paradene Resins	lb.	.065 /	.075
Paraplex 5-B	lb.	.315 /	.3775
AL-111	lb.	.32 /	.3275
G-25	lb.	.79 /	.80
-40	lb.	.51 /	.52
-50	lb.	.4025/	.4275
-53	lb.	.45 /	.475
-60	lb.	.325	.35
-62	lb.	.35	.375
RG-7	lb.	.35 /	.355
-8	lb.	.535 /	.5425
-10	lb.	.54 /	.5475
Pepton 22	lb.	.79 /	.82
Philrich 5	gal.	.11	
Picco Resins	lb.	.13 /	.185
Aromatic Plasticizers	lb.	.05 /	.065
480 Oilproof Series	lb.	.18 /	.23
Liquid Resin D-165 (Y)	lb.	.06 /	.075
(Z-3)	lb.	.07 /	.085
(Z-6)	lb.	.08 /	.095
S. O. S.	gal.	.29 /	.34
Piccocizers	lb.	.04 /	.055
Piccolastic Resins	lb.	.1855/	.34
Piccolyte Resins	lb.	.185 /	.25
Piccopale Resins	lb.	.12 /	.135
Piccoumaron Resins	lb.	.07 /	.185
Piccovars	lb.	.145 /	.20
Piccovol	lb.	.025 /	.038
Pictar	gal.	.25 /	.30
Pigmentar	lb.	.0427/	.0712
Pigmentaroil	lb.	.0427/	.0712
Pine Tar, American	lb.	.0438/	.0712
Sunny South	lb.	.0427/	.0712
Pine Tar Oil, American	lb.	.0438/	.0712
Sunny South	lb.	.0427/	.0712
Pitch, Burgundy			
Sunny South	lb.	.098 /	.1025

Plasticizers			
42	lb.	$0.34 /	$0.40
B	lb.	.35 /	.45
DP-520	lb.	.435 /	.455
MP	lb.	.035 /	.0755
MT-511	lb.	.535 /	.565
ODN	lb.	.32 /	.37
PX series	lb.	.27 /	.69
SC	lb.	.54 /	.63
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
DBE	lb.	.50 /	.55
MGB	lb.	.32 /	.40
SP-2	lb.	.43 /	.48
VS	lb.	.40 /	.475
Plastogen	lb.	.0775/	.08
Plastone	lb.	.22 /	.30
Polycizers	lb.	.40 /	.4775
PT67 Light Pine Oil	gal.	.60	
101 Pine Tar Oil	lb.	.0427/	.0601
Pine Tars	lb.	.0427/	.0601
R-19, R-21 Resins	lb.	.1075	
Reogen	lb.	.1325/	.135
Resin C pitch	lb.	.0225/	.031
R6-3	lb.	.38 /	.40
Resinex 10, 25, 50, 110	lb.	.04 /	.045
70	lb.	.0325/	.0375
85, 100	lb.	.035 /	.04
115	lb.	.0375/	.0425
L-2, L-3, L-4, L-5	lb.	.0225/	.03
Rosin Oil, Sunny South	gal.	.58 /	.875
RPA No. 2	lb.	.78	
3	lb.	.47	
Conc.	lb.	.97	
5	lb.	.59	
RSN Flux	gal.	.10 /	.19
Rubber Oil B-5	lb.	.0225/	.0355
Rubberol	lb.	.2575/	.2725
Santicizer 1-H	lb.	.50 /	.51
3	lb.	.46 /	.47
8	lb.	.43 /	.44
9	lb.	.39 /	.42
140	lb.	.33 /	.46
141	lb.	.34 /	.37
160	lb.	.25 /	.28
601, 602	lb.	.32	
603	lb.	.27	
B-16	lb.	.4875/	.4975
E-15	lb.	.5075/	.5375
M-17	lb.	.4275/	.4575
Sebacic acid, purified,			
comml	lb.	.64 /	.70
Binney & Smith	lb.	.64 /	.76
Hardesty	lb.	.64 /	.76
C.P.			
Binney & Smith	lb.	.72 /	.84
Hardesty	lb.	.72 /	.84
Sherolatum Petrolatum	lb.	.05 /	.10
Softener #20	gal.	.10 /	.20
Special Rubber Resin 100	lb.	.1675/	.2175
Staflex AX	lb.	.43	
DBES	lb.	.61 /	.635
Syn-Tac	gal.	.33 /	.35
Synthol	lb.	.2475	
Thiokol TP-90B	lb.	.59	
-95	lb.	.65	
Tricresyl phosphate, comml	lb.	.33 /	.36
Monsanto	lb.	.33 /	.36
Naugatuck	lb.	.33 /	.36
Triphenyl phosphate,			
comml	lb.	.39 /	.40
Monsanto	lb.	.39 /	.40
Turgum S	lb.	.1075/	.1175
Tysonite	lb.	.24 /	.2475
United	gal.	.69 /	1.20
X-1 Resinous Oil	lb.	.021 /	.0275

Reclaiming Oils

Acintol C, P	lb.	.02 /	.03
Bardol, 639	lb.	.0275/	.0375
B	lb.	.0625/	.065
BRH 2	lb.	.0213/	.0351
BRT 3	lb.	.018 /	.0265
4	lb.	.025 /	.026
7	lb.	.03 /	.031
BRV	lb.	.0475/	.0565
Burco-RA	lb.	.053 /	.0805
BWH-1	lb.	.16 /	.18
Dipolymer Oil	gal.	.33 /	.43
Dispersing Oil No. 10	lb.	.06 /	.0625
G. B. Oils	gal.	.10 /	.24
Heavy Resin Oil	lb.	.0225/	.0375
LX-777	gal.	.23 /	.33
No. 3186	gal.	.28 /	.295
Picco 6535	gal.	.25 /	.30
C-33	gal.	.215 /	.315
-42	gal.	.23 /	.33
D-4	gal.	.27 /	.37
E-5	gal.	.25 /	.35
Q-Oil	gal.	.286 /	.36
PT 67	gal.	.60	
101 Pine Tar Oil	lb.	.0427/	.0601
150 Pine Solvent	gal.	.44	
Reclaiming Oil #3186	gal.	.28 /	.385
-G	gal.	.25 /	.365
4039-M	gal.	.3275/	.3975
-Y	gal.	.30 /	.37
RR-10	lb.	.36	
S. R. O.	lb.	.015 /	.0225
X-1 Resinous Oil	lb.	.021 /	.03

Reinforcers, Other Than Carbon Black

American Resinous Chemical			
978-42B	lb.	.18 /	.19
1073-18B	lb.	.135 /	.145
1294-36B	lb.	.115 /	.125
1301-12B	lb.	.15 /	.16

Angelo Shellacs	lb.	$0.485 /	$0.7325
BRC 20	lb.	.15 /	.175
22	lb.	.025 /	.0275
30	lb.	.0125/	.021
521	lb.	.019 /	.02
Bunarex Resins	lb.	.065 /	.1225
Cab-o-sil	lb.	.68 /	.75
Calcene NC	ton	72.50 /	92.50
TM	ton	75.00 /	95.00
Calco S. A.	lb.	.85 /	.88
Clays			
Aiken	ton	14.00	
Buca	ton	45.00	
Burgess HC-75	ton	12.00 /	30.00
HC-80	ton	14.00 /	32.00
Iceberg	ton	50.00 /	60.00
Pigment No. 20	ton	35.00 /	60.00
30	ton	37.00 /	60.00
Catalpo	ton	35.00	
Crown	ton	14.00 /	33.00
Dixie	ton	14.00	
Franklin	ton	13.50 /	35.25
L. G. B.	ton	17.00	
Paragon	ton	13.50 /	33.00
Pigment No. 33	ton	37.00	
Recco	ton	14.00	
Suprex	ton	14.00 /	33.50
Swanee	ton	12.50	
Whitetex	ton	50.00	
Windsor	ton	14.00 /	30.00
Witco No. 1	ton	14.00 /	30.00
No. 2	ton	13.50 /	30.00
Clearcarb	lb.	.1175/	.1225
Cumar Resins	lb.	.065 /	.17
Darex Resins	lb.	.42 /	.49
Diatomaceous silica	ton	32.00 /	48.00
Good-rite Resin 50	lb.	.39 /	.41
K Series Polymers	lb.	.15 /	.37
Hi-Sil 101	lb.	.10 /	.115
233	lb.	.09 /	.105
X303	lb.	.40 /	.45
Indulins	lb.	.06 /	.08
Kralac A-EP	lb.	.43 /	.54
Laminar	ton	30.00	
Magnesium Carbonate, Merck	lb.	.105 /	.12
Marbon Resins	lb.	.39 /	.46
Multifex	ton	140.00 /	155.00
MM	ton	110.00 /	125.00
Super	ton	160.00 /	175.00
Neville Resins			
465	lb.	.07 /	.0825
G	lb.	.13	
LX-509	lb.	.35	
Nebony	lb.	.04 /	.0575
Paradene	lb.	.065 /	.075
R	lb.	.13 /	.18
Para Resins 2457, 2718	lb.	.04 /	.45
Parapol S-Polymers	lb.	.44	
Picco Resins	lb.	.13 /	.185
Piccolyte Resins	lb.	.205 /	.275
Piccoumaron Resins	lb.	.07 /	.19
Piccovars	lb.	.145 /	.20
Pliolite NR types	lb.	.98 /	1.33
S-3, -6	lb.	.42 /	.49
-6B	lb.	.39 /	.46
Purecal M	ton	56.75 /	71.75
SC, T	ton	110.00 /	125.00
U	ton	120.00 /	135.00
R-B-H 510	lb.	.15 /	.22
Resinex	lb.	.0325/	.0425
Rubber Resin LM-4	lb.	.28 /	.35
Silene EF	ton	120.00 /	140.00
Silvacons	ton	55.00 /	85.00
Witcarb R	ton	105.00 /	120.00
-12	ton	45.00 /	66.00
Zeolex 23	ton	120.00 /	140.00
Zinc oxide, commercial†	lb.	.135 /	.1775

Retarders

Benzoic acid TBAO-2	lb.	.44	
Delac J	lb.	.55 /	.60
E-S-E-N	lb.	.35 /	.37
Good-rite Vultrol	lb.	.62 /	.66
R-17 Resin	lb.	.1075/	.36
Retarder ASA	lb.	.57	
PD	lb.	.35 /	.37
W	lb.	.45	
Retardex	lb.	.47 /	.50
Thionex	lb.	1.14	

Solvents

Bondogen	lb.	.55 /	.60
Butyrolactone	lb.	.60 /	.65
Cosol #1	gal.	.37 /	.43
#2	gal.	.42 /	.48
Dichloro Pentanes	lb.	.04 /	.07
Dipentene DD	lb.	.265 /	.57
Ethylene dichloride, comml.	lb.	.09 /	.1225
Hi-Flash 2-50-W	gal.	.41	
Pale yellow	gal.	.39	
LX-572	gal.	.27 /	.32
-748	gal.	.16 /	.23
n-Methyl-2-pyrrolidone	lb.	.75 /	.80
Neville Nos. 100, 104	gal.	.52 /	.60
106	gal.	.38 /	.46
Nevsol B	gal.	.20 /	.30
H, 200	gal.	.19 /	.29
HF, T, 30	gal.	.24 /	.34
Penetrell	gal.	.265 /	.57
Picco Hi-Solv Solvents	gal.	.16 /	48
Pine Oil DD	lb.	.1125/	.1355
PT 150 Pine Solvent	gal.	.44	
Skellysolve-E	gal.	$0.153	
-H	gal.	.133	
-R, -V	gal.	.109	
-S	gal.	.099	
Stauffer Carbon Disulphide	lb.	.0525/	$0.085
Tetrachloride	lb.	.0825/	.475

Synthetic Rubbers and Latices

PRIVATELY PRODUCED

Butaprene Latex (dry wt.)			
NL types	lb.	.47 /	.52
NXM types	lb.	.55 /	.60
Butaprene NAA	lb.	.54 /	.55
NF	lb.	.49 /	.50
NL	lb.	.50 /	.51
NXM	lb.	.58 /	.59
Butyl 035 (GR-I-35), 150 (GR-I-50), 215 (GR-I-15), 217 (GR-I-17), 218 (GR-I-18), 325 (GR-I-25)	lb.	.23 /	.26
Chemigum 30N4NS, 50N4NS	lb.	.50 /	.52
N1NS	lb.	.64 /	.66
N3NS	lb.	.58 /	.60
N6, N7	lb.	.50 /	.52
Chemigum Latex (dry wt.)			
101 types	lb.	.35 /	.42
200, 245 types	lb.	.47 /	.55
235 types	lb.	.55 /	.63
Hycar 1001, 1041	lb.	.53 /	.59
1002, 1042, 1043	lb.	.50 /	.51
1014, 1312	lb.	.60 /	.61
1411	lb.	.62 /	.63
1432	lb.	.59 /	.60
1441	lb.	.64 /	.65
Hycar Latex (dry wt.)			
1512, 1552, 1562, 1577	lb.	.46 /	.52
1551, 1561	lb.	.54 /	.60
1571	lb.	.59 /	.65
1572	lb.	.51 /	.57
Hypalon	lb.	.95 /	1.01
Indulin-70-GR-S,	lb.	.22 /	.23
Neoprene Latex (dry wt.)			
Type 571, 842-A	lb.	.37 /	.48
572	lb.	.39 /	.50
601-A	lb.	.40 /	.51
735, 736	lb.	.38 /	.49
950	lb.	.47 /	.58
Neoprene Type AC, CG	lb.	.55 /	.58
GN, GN-A	lb.	.41 /	.44
GRT, S	lb.	.42 /	45
KNR	lb.	.75 /	.78
Q	lb.	1.00 /	1.03
W, WHV	lb.	.39	
WRT	lb.	.45 /	.48
Paracril 18-80	lb.	.60 /	.61
AJ	lb.	.485 /	.495
B, BJ	lb.	.50 /	.51
BV	lb.	.51 /	.52
C	lb.	.58 /	.59
CS, CV	lb.	.59 /	.60
Paraplex X-100	lb.	1.00	
Silastic	lb.	2.30 /	4.05
Thiokol LP-2, -3, -32, -33	lb.	.96	
-8, -38	lb.	1.25	
PR-1	lb.	.95	
Type A	lb.	.47	
FA	lb.	.69	
ST	lb.	1.00	
Thiokol Latex (dry wt.)			
Type MF	lb.	.85	
MX	lb.	.70	
WD-2	lb.	.92	
-5	lb.	.95	
-6, -7	lb.	.70	
Vistanex types	lb.	.45	

GOVERNMENT

Cold GR-S Black Masterbatches

Staining			
1600, 1601, 1602	lb.	.185	

Cold GR-S Oil Black Masterbatches

Staining			
1801	lb.	.17	

Tackifiers

American Resinous Chemical			
A25, A26, 716-30	lb.	.18 /	.19
555-40R	lb.	.185 /	.205
620-32B	lb.	.20 /	.21
716-35	lb.	.17 /	.18
1041-21	lb.	.165 /	.175
Acintol R	lb.	.065 /	.07
Bardol, 639	lb.	.0275/	.0375
BRH 2	lb.	.0213/	.0351
Bunarex Resins	lb.	.065 /	.1225
Chlorowax 70	lb.	18 /	.24
Contogums	lb.	.0875/	.11
Cumar Resins	lb.	.065 /	.17
Galex W-100	lb.	.155 /	.17
W-100D	lb.	.1525/	.1625
Indopol H-35	gal.	.65 /	.81
H-50	gal.	.70 /	.86
H-100	gal.	.85 /	1.05
H-300	gal.	1.00 /	1.21
L-10	gal.	.40 /	.56
L-50	gal.	.45 /	.61
L-100	gal.	.55 /	.71
Kenflex resins	lb.	.18 /	.27
Koresin	lb.	.90 /	1.10
Natac	lb.	.12 /	.13
Nevindene	lb.	.15 /	.18
Picco Resins	lb.	.13 /	.185
Piccolastic Resins	lb.	$0.1855/	$0.34
Piccolyte Resins	lb.	.185 /	.25
Piccopale Resins	lb.	.95 /	.16
Piccoumaron Resins	lb.	.07 /	.185
R-B-H 510	lb.	.15 /	.22
Roelflex 1118A	lb.	.39	
Synthetic 100	lb.	.41	
Synthol	lb.	.2475/	.2625
United	gal.	.69 /	1.20

Vulcanizing Agents

Dibenzo G-M-F	lb.	2.60	
G-M-F #113, #117	lb.	.90	
Ko-Blend I, S	lb.	.385	
Litharge (*See Accelerator-Activators, Inorganic*)			
Magnesium oxide	lb.	.2525/	.38
Merck, Light Calcined	lb.	.2525/	.26
Extra Light Calcined	lb.	.2925/	.30
Red lead (*See Accelerator-Activators, Inorganic*)			
Sufsal R	lb.	1.50	
Sulfur flour, comml.	100 lbs.	2.30 /	3.05
Aero	100 lbs.	2.15 /	7.50
Crystex	lb.	.195 /	.23
Insoluble 60	lb.	.125 /	.13
Rubbermakers	100 lbs.	2.40 /	4.30
Stauffer	lb.	.024 /	.0515
Telloy	lb.	2.50	
VA-7	lb.	.50 /	.60
Vandex	lb.	6.00	
Vultac No. 2	lb.	.47 /	.755
3	lb.	.51 /	.795
White lead silicate (*See Accelerator-Activators, Inorganic*)			

Financial

(Concluded from page 266)

Sun Oil Co., Philadelphia, Pa., and subsidiaries. For 1954: net income, $40,343,791, equal to $4.17 each on 9,569,934 common shares, against $45,153,602, or $4.67 each on 7,656,087 shares, in 1953; federal income taxes, $9,700,000, against $16,500,000.

Thiokol Chemical Corp., Trenton, N. J. For 1954: net profit, $270,776, equal to 76¢ each on 353,176 capital shares, compared with $151,142, or 45¢ each on 333,459 shares, in 1953; net sales, $10,029,190, against $8,190,708; income taxes, $294,000, against $97,000.

Union Carbide & Carbon Corp., New York, N. Y., and subsidiaries. First quarter, 1955: net profit, $28,397,079, equal to 98¢ each on 28,952,794 capital shares, compared with $21,443,770, or 74¢ a share, a year earlier; net sales, $263,041,109, against $220,990,171.

United States Rubber Co., New York, N. Y. Three months ended March 31, 1955: net earnings, $9,940,276, equal to $1.63 a share, against $7,545,109, or $1.18 a share, in the like period last year; net sales, $225,161,081, against $190,103,720.

Brazil

(Continued from page 246)

440,564 passenger car tires, 20,263 tires for farm tractors and other farm machinery; 1,131 airplane tires; the remaining 59,310 tires included tires for motorcycles, light trucks, and commercial vehicles. Inner tubes for all motor vehicles numbered 565,749. Output also included 417,250 cycle tires and 384,318 cycle tubes.

CLASSIFIED ADVERTISEMENTS

ALL CLASSIFIED ADVERTISING MUST BE PAID IN ADVANCE

GENERAL RATES	SITUATION WANTED RATES	SITUATIONS OPEN RATES
Light face type $1.25 per line (ten words)	Light face type 40c per line (ten words)	Light face type $1.00 per line (ten words)
Bold face type $1.60 per line (eight words)	Bold face type 55c per line (eight words)	Bold face type $1.40 per line (eight words)
Allow nine words for keyed address.		*Letter replies forwarded without charge, but no packages or samples.*

Address All Replies to New York Office at 386 Fourth Avenue, New York 16, N. Y.

SITUATIONS OPEN

SITUATIONS OPEN (Continued)

SITUATIONS OPEN (Continued)

MECHANICAL GOODS MOLD DESIGNER

Mechanical Rubber Goods Div. of a Tire and Rubber Company in Ohio requires an experienced mechanical mold designer for a permanent position. Write giving full particulars regarding age, experience, education, and salary expected. Replies held confidential. Address Box No. 1720, care of RUBBER WORLD.

SITUATIONS WANTED

PLANT MANAGER

Chemical Engineer, over 25 years' experience in Tires, Tubes, Extruded and Molded goods. Proven ability in compounding, production, management, labor relations. Desires position where experience can be utilized.

ADDRESS BOX NO. 1707, c/o RUBBER WORLD

PRODUCTION MANAGER, TECHNICAL DIRECTOR, OR SUPERvisor available. Strong practical experience for production of mechanicals, sponge rubbers, cements, adhesives, and plastics extrusion—compression molded. Low cost, highest production minded with greatest departmental efficiency. Address Box No. 1708, care of RUBBER WORLD.

DEVELOPMENT ENGINEER & TECHNOLOGIST

Rubber and plastics engineer seeks new connection with progressive, well-established organization. Over 25 years' experience continuously in the chemical and development fields of molding, fabric coating, paper treatment, pressure-sensitives, and product development in rubber, latex, and synthetic resins, including polyesters. Also diversified chemical fields covering laboratory direction, engineering executive and consulting work. B.S. in chemistry, with mechanical design and plant layout experience. Patents registered and outstanding commercial development credits. Desire eastern or N. Y. metropolitan area in rubber, plastics, or allied fields. Address Box No. 1709, care of RUBBER WORLD.

RUBBER AND LATEX CHEMIST WITH BROAD EXPERIENCE in all types synthetic and natural elastomers. Knows latex emulsion and rubber compounding. Capable and experienced in management, production and general latex compounding. Address Box No. 1710, care of RUBBER WORLD.

VINYL CHEMIST, EXPERIENCED IN EVALUATING RESINS, stabilizers, and plasticizers, seeks new position. Now employed, but would like position with broader horizon. Address Box No. 1711, care of RUBBER WORLD.

THESE ARE AVAILABLE TO YOU:

1. Extensive experience in compounding rubbers and plastics (dry and latex). 2. Proven ability to organize and direct a laboratory program reflecting the needs of both sales and production. Eastern location preferred. Address Box No. 1723, care of RUBBER WORLD.

MACHINERY & SUPPLIES FOR SALE

FARREL 16" X 48" AND 15" X 36", 2-ROLL RUBBER MILLS, and sizes up to 84". New and used lab. 6" x 12" & 6" x 16" Mills and Calenders. American Tool 300-gallon Churns. Extruders 1" to 6". Baker-Perkins Jacketed Mixers 100, 50, and 9 gals. HPM 200-ton Hydr. Press 30" x 48" platens. Brunswick 200-ton 21" x 21" platens. 150-ton, 20" x 20" platens. Large stock Hydraulic Presses 12" x 12" to 48" x 48" platens. Hydraulic Pumps and Accumulators. Rotary Cutters. Stokes Molding Presses. Single-Punch & Rotary Preform Machines. Banbury Mixers, Crushers, Churns, Bale Cutters, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT CO., 107—8th St., Brooklyn 15, N. Y. STerling 8-1944.

FOR SALE: 1—BOLLING 8" x 16"—3-ROLL VERTICAL CALENder; 2—16" x 40" rubber mills, 40-HP motor each; 1—18" x 50"—3-roll vertical calender; 1—HPM hydropneumatic accumulator, 200/3,000#; also hydraulic presses, mixers, vulcanizers, et cetera. CHEMICAL & PROCESS MACHINERY CORP., 146 Grand Street, New York 13, N. Y.

EXTRUDER 4" ALLEN FIRST-CLASS CONDITION. NO MOTOR. Recently rebuilt. Will sell. Reasonable. Specifications available. Private owner. Dan Drennan, 12845 Dunrobin Ave., Downey, Calif.

RUBBER HARDNESS

THE LANGUAGE OF THE RUBBER INDUSTRY SINCE 1915

DUROMETER

VARIOUS MODELS FOR TESTING THE ENTIRE RANGE

TECHNICAL DATA ON REQUEST

THE SHORE INSTRUMENT & MFG. CO., INC.

90-35 VAN WYCK EXPRESSWAY
JAMAICA 2, N. Y.

Economical **NEW** Efficient

Mills - Spreaders - Churns
Mixers - Hydraulic Presses
Calenders

...GUARANTEED...

Rebuilt Machinery for Rubber and Plastics

LAWRENCE N. BARRY

41 Locust Street — Medford, Mass.

USED MACHINERY
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Index to Advertisers

This index is maintained for the convenience of our readers. It is not part of the advertisers' contract and RUBBER WORLD assumes no responsibility to advertisers for its correctness.

A

Adamson United Co. ... —
Aetna-Standard Engineering Co. ... 176
Akron Equipment Co., The ... 271
Akron Rubber Machinery Co., Inc., The ... 280
Albert, L., & Son ... 279
Alco Oil & Chemical Corp. ... 186
Aluminum Flake Co. ... 277
American Cyanamid Co., Intermediate & Rubber Chemicals Dept. ... 255
American Maintenance Supply Co. ... —
American Rayon Institute ... 160, 161
American Resinous Chemicals Corp. ... —
American Steel Foundries (Elmes Engineering Division) ... 248
American Zinc Sales Co. ... —
Ames, B. C., Co. ... —
Angier Products, Inc. ... 165
Argus Chemical Corp. ... —

B

Baker Castor Oil Co., The ... 177
Barco Manufacturing Co. ... —
Barr Rubber Products Co., The ... 260
Barry, Lawrence N. ... 279
Binney & Smith, Inc. Insert ... 223-224
Black Rock Mfg. Co. ... 265
Bolling, Stewart, & Co., Inc. ... —
Bridgwater Machine Co. (Athens Machine Division) ... 173
Brockton Tool Co. ... 280
Brooklyn Color Works, Inc. ... —

C

Cabot, Godfrey L., Inc. ... Back Cover
Cambridge Instrument Co., Inc. ... 269
Carbide & Carbon Chemicals Co., A Division of Union Carbide & Carbon Corp. ... 251
Carey, Philip, Mfg. Co., The ... 260
Carter Bell Mfg. Co., The ... 188
Cary Chemicals Inc. ... 174
Claremont Waste Mfg. Co. ... 271
CLASSIFIED ADVERTISEMENTS ... 278, 279, 280
Cleveland Liner & Mfg. Co., The ... Inside Back Cover
Columbia-Southern Chemical Corp. ... 181
Columbian Carbon Co. Insert ... 223-224
Columbian Carbon Co. (Mapico Color Division) ... 256
CONSULTANTS & ENGINEERS ... 260
Continental Carbon Co. ... 273
Continental Machinery Co., Inc. ... —

D

DPR Incorporated, A Subsidiary of H. V. Hardman Co. ... 267
Darlington Chemicals, Inc. ... 269
Dayton Rubber Co., The ... 254
Diamond Alkali Co. ... 274
Dow Corning Corp. ... —
du Pont de Nemours, E. I., & Co. ... Inside Front Cover, 185
Durez Plastics & Chemicals, Inc. ... 182

E

Eagle-Picher Co., The ... 271
Emery Industries, Inc. ... 241
Enjay Co., Inc. ... 244, 245
Erie Engine & Mfg. Co. ... —
Erie Foundry Co. ... 154

F

Falls Engineering & Machine Co., The ... 269
Farrel-Birmingham Co., Inc. ... 147
Ferry Machine Co. ... —
Flexo Supply Co., The ... —
Flightex Fabrics, Inc. ... 267
French Oil Mill Machinery Co., The ... —

G

Gale, C. J. ... 280
Gammeter, W. F., Co., The ... 277
Gelb, R., & Sons, Inc. ... 279
General Latex & Chemical Corp. ... 153
General Magnesite & Magnesia Co. ... 277
General Tire & Rubber Co., The (Chemical Division) ... 143
Genseke Brothers ... —
Gidley Research Institute ... 260
Glidden Co., The (Chemicals, Pigments, Metals Division) ... —
Goodrich, B. F., Chemical Co. ... 135
Goodyear Tire & Rubber Co., Inc., The (Chemical Division) ... 138, 139
Gross, A., & Co. ... 251

H

Hale & Kullgren, Inc. ... 176, 260
Hall, C. P., Co., The ... 140
Harchem Division, Wallace & Tiernan, Inc. ... —
Harwick Standard Chemical Co. ... 167
Hercules Powder Co. ... 158
Heveatex Corp. ... —
Hobbs Manufacturing Co. ... 248
Hoggson & Pettis Mfg. Co., The ... 265
Holliston Mills, Inc., The ... 186
Holmes, Stanley H., Co. ... 250
Home Rubber Co. ... 277
Howe Machinery Co., Inc. ... 260
Huber, J. M., Corp. ... 190

I

Indoil Chemical Co. ... —
Institution of the Rubber Industry ... —

J

Johnson Corp., The ... —

L

Lambert, E. P., Co. ... —
Liquid Carbonic Corp., The ... 247

M

Maimin, H., Co., Inc. ... 252
Marbon Chemical Division of Borg-Warner ... 149
McNeil Machine & Engineering Co., The ... 156, 157
Monsanto Chemical Co. ... —
Morris, T. W., Trimming Machines ... —
Muehlstein, H., & Co., Inc. ... 243

N

National Aniline Division, Allied Chemical & Dye Corp. ... 159
National Chemical & Plastics Co., The ... 269
National Rubber Machinery Co. ... 187
National Sherardizing & Machine Co., The ... 260
National-Standard Co. ... 178
Naugatuck Chemical Division of U. S. Rubber Co. ... 137
Neville Chemical Co. ... 163
New Jersey Zinc Co., The ... —

O

Oakes, E. T., Corp., The ... 150
Oakite Products, Inc. ... 267
Ohio-Apex Division, Food Machinery & Chemical Corp. ... —
Oronite Chemical Co. ... 261

P

Pan American Chemicals, Division Pan American Refining Corp. ... 257
Pasadena Hydraulics, Inc. ... 258
Paterson Parchment Paper Co. ... —
Pennsylvania Industrial Chemical Corp. ... 155
Pequanoc Rubber Co. ... 148, 280
Phillips Chemical Co. ... 136; Insert 169-172
Pittsburgh Coke & Chemical Co. ... —

R

Rand Rubber Co. ... —
Rare Metal Products Co. ... 265
Richardson, Sid, Carbon Co. ... 282
Rotex Rubber Co. ... 280
Royle, John, & Sons ... 184
Rubber Corp. of America ... 259
Rubber Regenerating Co., Ltd., The ... 249

S

St. Joseph Lead Co. ... 146
Schlosser, H. A., & Co. ... 260, 277
Scott Testers, Inc. ... 298
Sharples Chemicals Inc. ... 189
Shaw, Francis, & Co., Ltd. ... 162
Shell Chemical Corp., Synthetic Rubber Sales Division ... 183
Shore Instrument & Manufacturing Co., Inc., The ... 279
Skelly Oil Co. ... 142
Skinner Engine Co., Rubber Machinery Division ... —
Snell, Foster D., Inc. ... 260
South Texas Tire Test Fleet ... 277
Southeastern Clay Co. ... 265
Southern Clays, Inc. ... —
Spadone Machine Co., Inc. ... 267
Stamford Rubber Supply Co., The ... 184
Stanley Electric Tools ... —
Stauffer Chemical Co. ... 175
Sun Oil Co. ... 239

T

Taylor Instrument Cos. ... 145
Taylor, Stiles & Co. ... 263
Thiokol Chemical Corp. ... —
Thomaston Mills ... 271
Timken Roller Bearing Co., The ... 141
Titanium Pigment Corp. ... 168
Turner Halsey Co. ... —

U

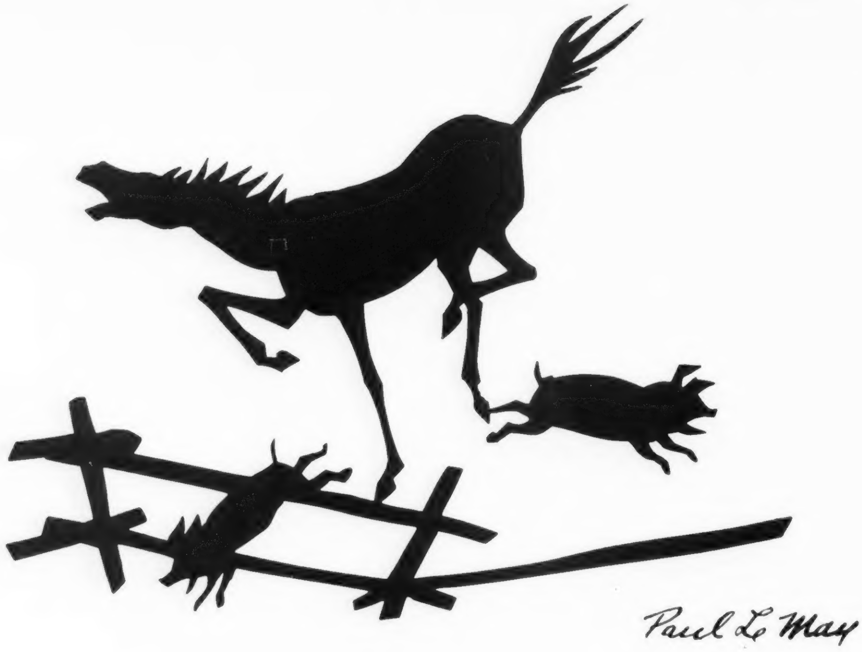
Union Carbide & Carbon Corp., Carbide & Carbon Chemicals Co. ... 251
United Carbon Co., Inc., Insert ... 151, 152
United Engineering & Foundry Co. ... —
United Rubber Machinery Exchange ... 279
U. S. Stoneware ... 252
Universal Oil Products Co. ... 179

V

Vanderbilt, R. T., Co., Inc. ... 192
Velsicol Corp. ... 144

W

Wade, L. C., Co., Inc. ... —
Watson-Standard Co. ... —
Wellington Sears Co. ... 166
Wellman Co. ... —
Western Supplies Co. ... 164
White, J. J., Products Co. ... —
Whittaker, Clark & Daniels, Inc. ... 254
Williams, C. K., & Co., Inc. ... 188
Witco Chemical Co. ... 253, 273
Woloch, George, Co., Inc. ... 258
Wood, R. D., Co. ... —



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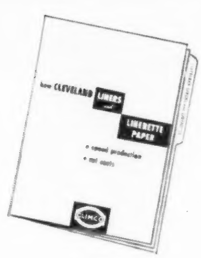

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